LEARNING ABOUT

2 c.1

INDICATOR

SDG Indicator 2.c.1 – Food price anomalies

Lesson: An introduction to food market analysis

Text-only version

Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

working for Zero Hunger

In this lesson

An introduction to food market analysis

This lesson introduces basic concepts in understanding how prices are determined in markets, and the factors that affect their variation. It examines the demand and supply curves and the four basic components of a price series. It then covers market integration and price transmission, and reviews differences between price volatility and price level.

Learning objectives

At the end of this lesson, you will be able to:

- indicate time series components;
- understand how market integration affects prices;
- define the supply and demand model;
- distinguish price level and price volatility.

Introduction

In a globalized world, keeping an eye on food commodity prices and a careful watch for price hikes has never been more important. In many countries, **market prices are sometimes the only source of information** available to assess the severity of a local shock to either access to, or availability of food.

Indicator of Food Price Anomalies (IFPA)

In this context, **indicators of Food Price Anomalies**, such as Indicator 2.c.1, are an important warning tool to measure how countries are progressing towards more stable markets and market prices.

To understand how to monitor food commodities prices, you need to know some basic concepts of food market analysis, such as market functioning and price determination. The lesson begins by discussing how prices are determined in markets, and then reviews a series of related topics with the following structure:

The supply and demand curve

Price series

Market integration and price transmission

Price volatility and price level

You may want to consult the whole lesson in sequence, or first review the topics that most interest you, and are most closely related to your area of work.

A supply and demand model

Prices are determined by supply and demand in markets.

Consumers choose specific goods and services that 'best' satisfy wants/needs within the limits imposed by income. **This is defined as the demand of a good or product or service.**

Sellers or suppliers are willing and able to make available different possible quantities of a good at all relevant prices. **This is defined as the supply of a good or product or service.**

Prices are determined from the interaction of what consumers demand, and what sellers or suppliers offer.

What is demand?

Demand for a good represents the behaviour of households or consumers, and the willingness and ability of consumers to purchase a good. In addition, it refers to how much of a good will be purchased at a given price.

Individual or market demand

Individual (or household) demand is the demand of a single consumer (or household).

Market demand is the sum of all the individual demands.

Example

Haja lives in a small agricultural village with her household.

"Our food consumption was mainly based on local agricultural production, including corn and rice. Due to a series of bad harvests, corn prices increased. We decided to reduce consumption of corn, given the increase in prices, and substituted corn consumption with other cereals, rice in particular, whose prices remained stable". - Haja

In the chart, you can review what happens to the demand for corn from Haja's household.

At current prices (P_1), **Q_1** is the annual quantity of corn consumed by Haja's household.

At new, higher prices (P_2), **Q_2** is the new quantity of corn consumed by Haja's household. The increase in price caused a decrease in the quantity demanded.
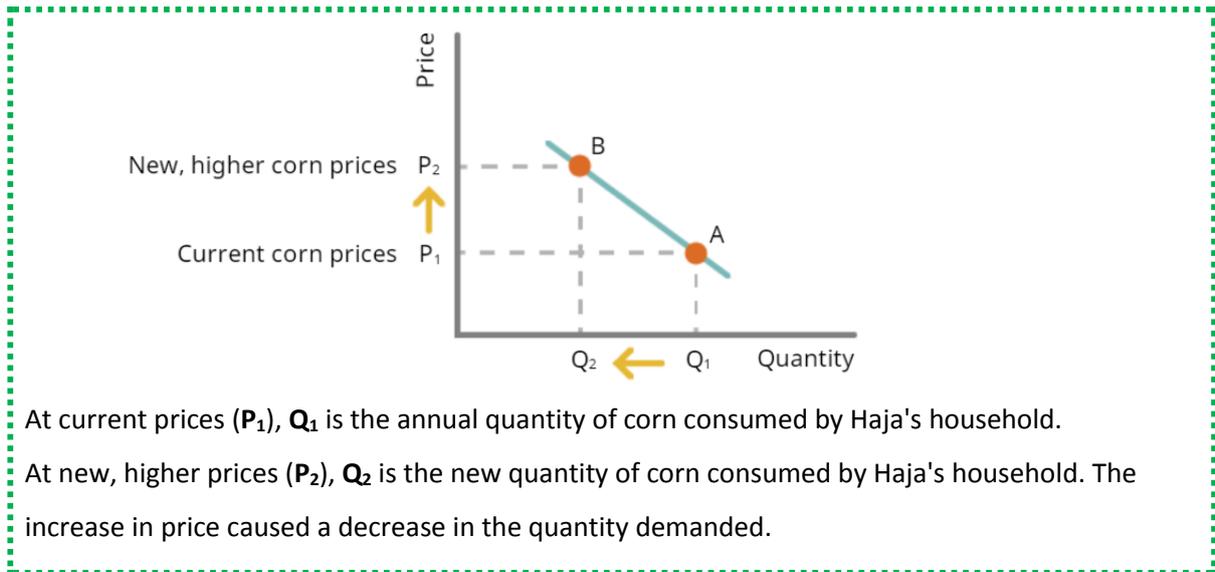
The demand curve

The demand curve represents the **mathematical relationship between the quantity consumed of a good and the price of that good**, given the prices of the other goods and the consumer's income.
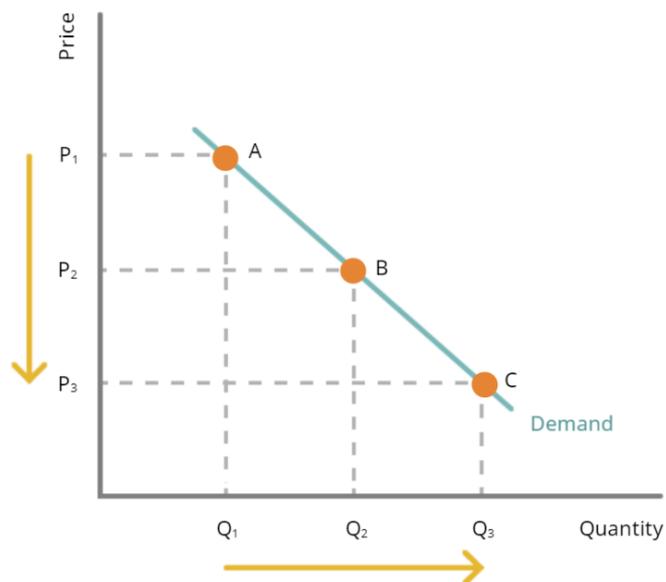
Therefore, when a good's own price changes, the quantity demanded will change. This is depicted as a movement along the same demand curve.

Price - Price is one of the factors that affect the demand for a good or service

As reviewed in Haja's example, there is an **inverse relationship** between the price of a product and the quantity demanded: the demand for a product increases with the decrease in its price, while other factors are constant, and vice versa.

Other factors that affect the demand for a good or service include:

Consumer preferences   **Macro factors**

Prices of related goods   **Other determinants**

Income

When any of the other demand curve determinants change, it will shift the entire curve (*Barkley, 2016*). This shift in demand is called a change in demand.
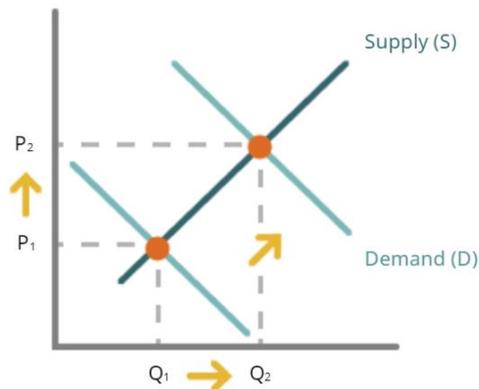

The demand change comes in two varieties: an **increase** in demand and a **decrease** in demand.

Let's suppose that an increase in consumer income leads to an increase in demand for a good or service. An **increase** in demand, caused by a change in the determinants we have just reviewed (income, consumer preferences, prices of related goods and other macro factors), causes a shift of the demand curve to the right. This generates an increase in price (P) and quantity (Q).

See how demand changes in the chart
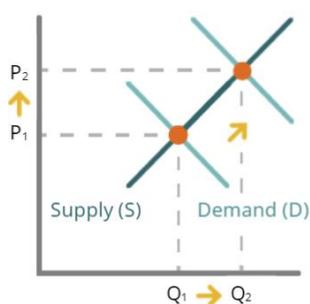
Let's suppose that changes in consumer preferences lead to a decrease in demand for a good or service. A **decrease** in demand, caused by a change in the determinants we have just reviewed (income, consumer preferences, prices of related goods and other macro factors), causes a leftward shift of the demand curve. It generates a decrease in price (P) and in quantity (Q).

See how demand changes in the chart
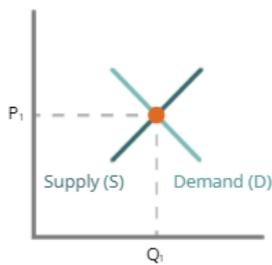
What is supply?

Supply is the amount of goods/commodities sellers are willing to sell at a particular market price.

Supply is the relationship between the price of a good and the quantity supplied, *ceteris paribus*.

Example

Anya has decided to produce organic rice…

"Consumers are increasingly attentive about the quality of food products and demand for organic food is increasing. Organic products are more expensive, which means a higher income for me. I will start with the production of organic rice to increase my earnings." - Anya

How is the relationship between the price of a good or service and the quality supplied represented?

The supply curve for an individual trader describes the relationship between the quantity of a good traded and the sale price of that good, given the purchase price and the prices of the other inputs.
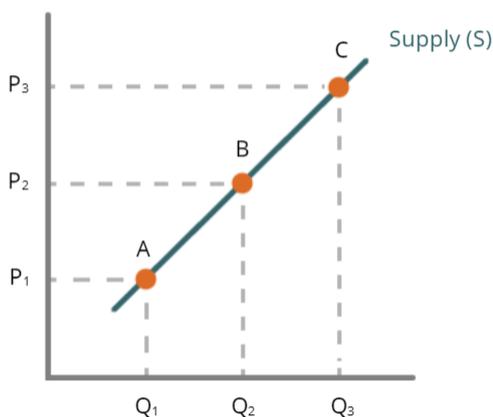
The supply curve

Determinants of the supply for a good or service include:

Own price

When price changes, the quantity supplied will change.

This is a movement along the same supply curve. A **movement** along a supply curve, caused by a change in the good's own price, is called a change in **quantity supplied**.
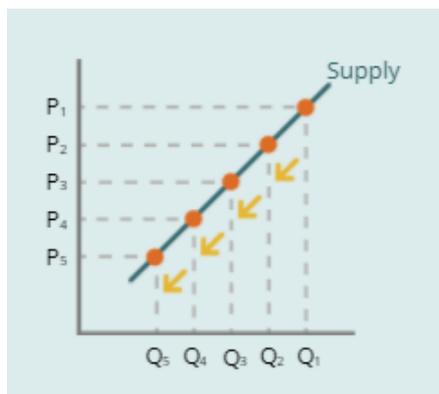
Production technology

Prices of inputs

Macro factors
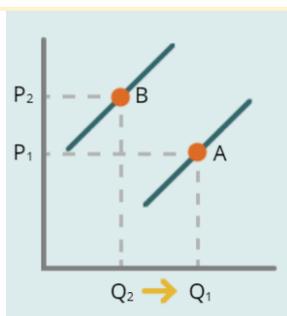
When factors other than price change, the supply curve will shift. When any of the other supply curve determinants change, it will shift the entire curve. A **shift** in the supply curve, caused by a change in any supply determinant other than the good's own price, is called a change in **supply**.

Example: Changes in supply determinants

If a new technology caused the production costs to go down suddenly, this would increase supply, and the selling price of the good would decrease.
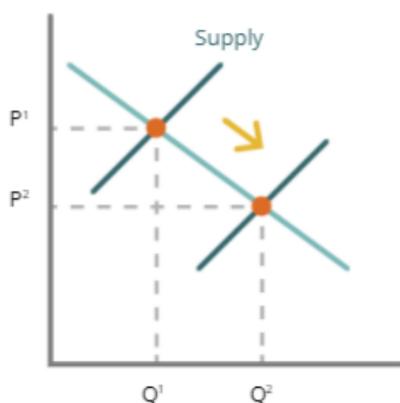
Examples: different scenarios and the effect on related demand or supply curves

When a good's own price changes, it is depicted as a movement along the demand or supply curve. When any of the other demand or supply curve determinants change, this will shift the entire curve.
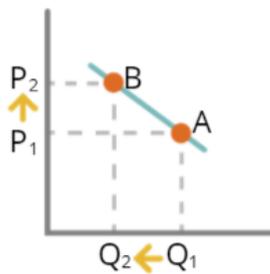
Due to a tax rise, cigarette prices increase. This determines a movement along the demand curve and a decrease in the quantity demanded.

Government decides to increase taxes on cigarettes, and this determines an increase in their prices.
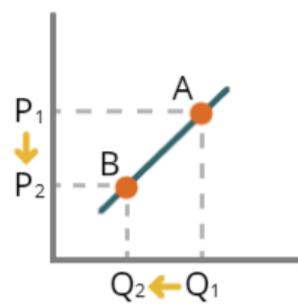
As oil prices fall, the quantity supplied also decreases. This is a movement along the same supply curve.

Due to the decrease in oil prices, many suppliers cannot cover their costs, and leave the oil market.
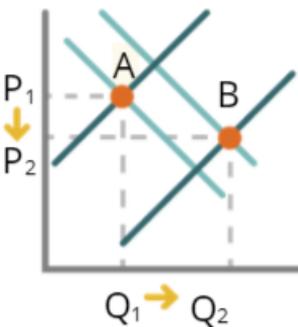
An increase in demand for electric cars moves the demand curve to the right. An increase in demand first moves prices higher. This causes an increase in supply (because suppliers are attracted by the possibility of earnings), followed by a decrease in price, as shown in this graph.

Environmental awareness improves, and demand for electric cars increases among consumers.

Equilibrium price

The interaction between supply and demand determines price.

The demand and supply curves intersect at point Q* (Quantity), corresponding to a P* (Price) which is the **equilibrium price** for this market. The equilibrium price is also called the market-clearing price.

At this price, the market is said to be cleared, or to be in equilibrium.
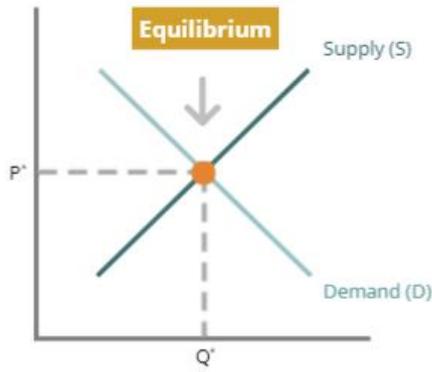
In a market in equilibrium, demand is exactly matched by supply.

What happens if supply and demand are not in equilibrium?

If prices are higher than the equilibrium price, as in correspondence of **P₁**.

There is an excess supply, that is again measured by the horizontal distance between the two curves.

At higher prices, suppliers wish to sell more than buyers wish to buy.
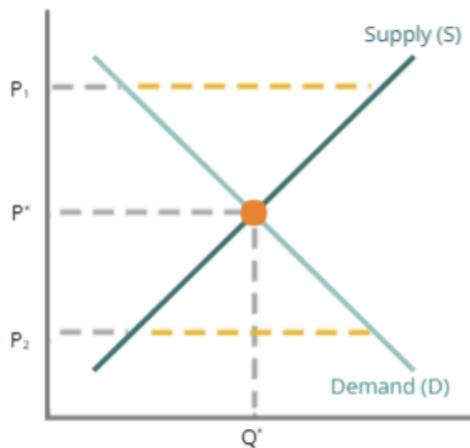
If prices are lower than the equilibrium price, as in correspondence of **P₂**.

There is an excess demand, measured by the horizontal distance between the two curves. At lower prices consumers wish to consume more than sellers wish to offer.

If the variables hold constant and the demand and supply functions do not change, an equilibrium can persist indefinitely, because none of the participants applies pressure to change the price.

Demand and supply shock

However, the equilibrium changes if a change occurs. It is important to distinguish between predictable and unpredictable variation, the latter being characterized in terms of shocks, or unexpected events. Shocks to both demand and supply **translate into price volatility**.

When a **shock[1]** occurs, one of the variables that was constant changes, causing a shift in either the demand curve or the supply curve.

✍ Demand curve

Demand-side shocks affect one or more of the components of aggregate demand. Examples of such shocks might include:

- ✓ Unexpected tax increases or cuts to welfare benefits
- ✓ Economic downturn in a major trading partner
- ✓ Financial crisis causing bank lending/credit to fall
- ✓ A higher than expected rise in unemployment rates

✍ Supply curve

Supply-side shocks affect short-run aggregate supply, and can also affect a country's long-run productive potential. Examples of such shocks might include:

- ✓ A steep rise in oil and gas prices or other commodities
- ✓ Political turmoil/strikes
- ✓ Natural disasters causing a sharp fall in production
- ✓ Unexpected breakthroughs in production technology

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[1] **Shocks** are events that are by and large unexpected and bring about changes in real economic growth, inflation and unemployment. All countries are exposed to external economic shocks to some degree.

IN DEPTH: A SUPPLY AND DEMAND MODEL
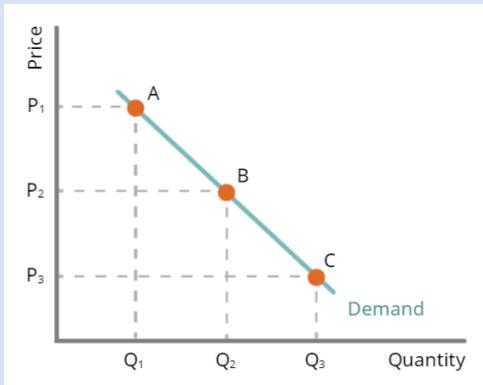
The demand curve represents the mathematical relationship between the price and quantity demanded of a good.

When the price changes, the quantity demanded will change. This is a movement along the same demand curve. In addition to prices, other factors affect the demand for a good or service. When factors other than the price change, the demand curve will shift.
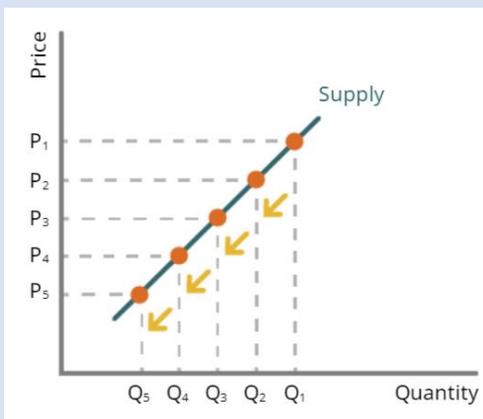
The supply curve is the relationship between the price of a good and the quantity supplied, *ceteris paribus*.

When the price changes, the quantity supplied will change. This is a movement along the same supply curve. When any of the other supply curve determinants change, it will shift the entire curve.

Aside from prices, the factors that affect **demand for a good i**nclude:

- **Consumer preferences -** Quality perceptions, new products or upgrades play a major role in influencing the individual and market demand of a product. All markets are shaped by collective and individual tastes and preferences. These patterns are partly shaped by culture, and partly implanted by information and knowledge of products and services (including the influence of advertising).

- **Income**
  Normal goods - For most goods, there is a positive relationship between a consumer's income and the amount of the good that he/she is willing and able to buy. In other words, for these goods, **when income rises the demand for the product will increase**; when

income falls, the demand for the product will decrease. These types of goods are called normal goods.

Inferior goods - Goods whose **demand varies inversely with income** are called inferior goods. For example, a consumer would prefer to purchase rice instead of millet, and cooking gas instead of kerosene, as a result of an increase in income. In such a cases, millet and kerosene are inferior goods for the consumer.

- **Price of related goods -** The price of related goods affects the demand of an item. Related goods include substitutes and complements in consumption.

  Substitutes in consumption are goods that are purchased either/or, such as hot dogs and hamburgers. If the price of hot dogs increases, at least some consumers will shift away from hot dogs and towards hamburgers.

  Complements in consumption are goods that are consumed together, for example hot dogs and hot dog buns. If the price of hot dogs increases, consumers will purchase fewer hot dogs and fewer buns. *Source: Barkley, 2016*

- **Macro factors**

  Population (size and growth)

  If the number of consumers increases in the market, the consumption capacity of consumers will also increase.

  Government programmes and policies

  This is one of the major factors that affect demand for a product. For example, if a product carries a high tax rate, this will increase its price and result in a decrease in demand. Similarly, the credit policies of a country encourage demand for a product, increasing consumers' incomes or decreasing product prices.

  Seasonality

  Seasonality is defined as a certain time series with repetitive or predictable patterns of demand. Everything from peak holiday sales activity to droughts due to seasonal weather changes can influence demand.

Legend

$Q_n = \int (P_n, P_s, P_c, D, Y, S)$ Where:

Q_n = Demand

P_n = Price

P_s = Price substitutes

P_c = Price complements

D = Taste

Y = Income

S = Macro-environment

P_n ↑ → ↓ Q_n	P_n ↓ → ↑ Q_n
P_s ↑ → ↑ Q_n	P_s ↓ → ↓ Q_n
P_c ↑ → ↓ Q_n	P_c ↓ → ↑ Q_n
D ↑ → ↑ Q_n	D ↓ → ↓ Q_n
Y ↑ → ↑ Q_n	Y ↓ → ↓ Q_n

And these are the forces affecting the **supply of a good**. Let's begin with prices:

- **Own price (Own price expectations)**

Input prices are important determinants of supply, since the supply curve represents the cost of production. In addition, new methods and techniques might increase the amount of food produced, hence technological change allows more output to be produced with the same level of inputs.

- **Production technology Price of inputs**

As technology improves, producers find that they are able to place goods on the market at a lower price than before. Input costs can also vary independently of technology.

- **Macro factors**

  Market interventions: Frequent market interventions include:

  ✓ **price ceilings**, which means that suppliers cannot legally charge more than a specific price. For instance, limits on apartment rents;

  ✓ **quotas**, which are physical restrictions on output;

  ✓ **taxes** and **subsidies** to inputs.

  Number of sellers: The number of sellers willing and able to buy a good affects the overall supply. Everything else being constant, if the number of sellers in a market increases, the market supply of their product increases.

  S**easons/weather patterns:** The supply of agricultural products is directly affected by weather conditions and the seasons. Supplies are low at the start of the harvest season, so prices are high. Prices are at their lowest when the crop reaches maturity in the main production areas. At the end of the season, prices usually increase again as supply

diminishes. Prices are generally highest during the off-season, when only a small percentage of farmers are able to grow crops.

Legend

$Q_n = \int (P_n, P_s, P_c, D, Y, S)$ Where:

Q_n = Supply

P_n = Price

P_i = Input costs

S = State of technology

E = Expectations

M = Macro/exogenous factors

P_n ⬆ → ⬆ Q_n	P_n ⬇ → ⬇ Q_n
P_i ⬆ → ⬇ Q_n	P_i ⬇ → ⬆ Q_n
S ⬆ → ⬆ Q_n	S ⬇ → ⬇ Q_n
E ⬆ → ⬆ Q_n	E ⬇ → ⬇ Q_n

Example

In this country, the last two cotton harvests have been damaged by adverse climatic conditions. There has been a fall in production of around 30%, almost half of all producers have suffered damage to their harvests and cotton prices have reached the highest level in the past five years.

The economic interpretation of the price situation in the country is the following:

The demand of cotton is stable, and the equilibrium at the lower quantity traded determines higher prices on the demand curve. In the example, cotton demand is stable and its supply decreases. This determines equilibrium at the lower quantity traded, and a higher price on the demand curve. In the short run, prices are good indicators of availability.

Time series

Observing how prices vary in time can be useful in food market analysis.

In this example, prices of white maize in Costa Rica have been observed, at regular intervals, over a specified period of time (from January 2011 to April 2016, in this example), and their sequence is reported in this graph. This is a time series (price series)[2].

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[2] A time series (price series) is a **sequence of numerical data points in successive order**. The price series tracks the movement of the chosen data points, such as a security's price, over a specified period of time, with data points recorded at regular intervals.

White maize price 2011-2016
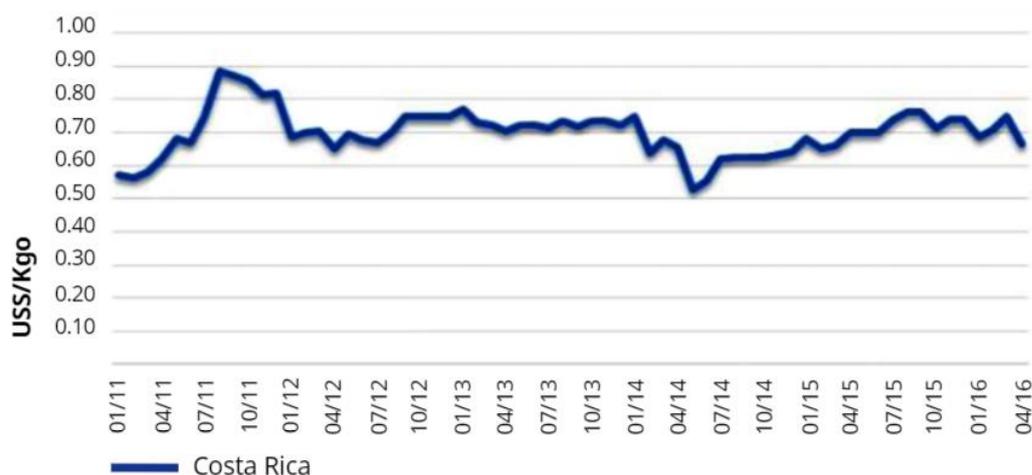
The components of a time series

If you examine a time series, you may want to know:

- ✓ Can seasonal fluctuations be identified?

- ✓ Can a trend be defined?

- ✓ Are there phases of expansion and contraction?

- ✓ Is there regularity in data variations?

White maize price 2011-2016 (Guatemala)
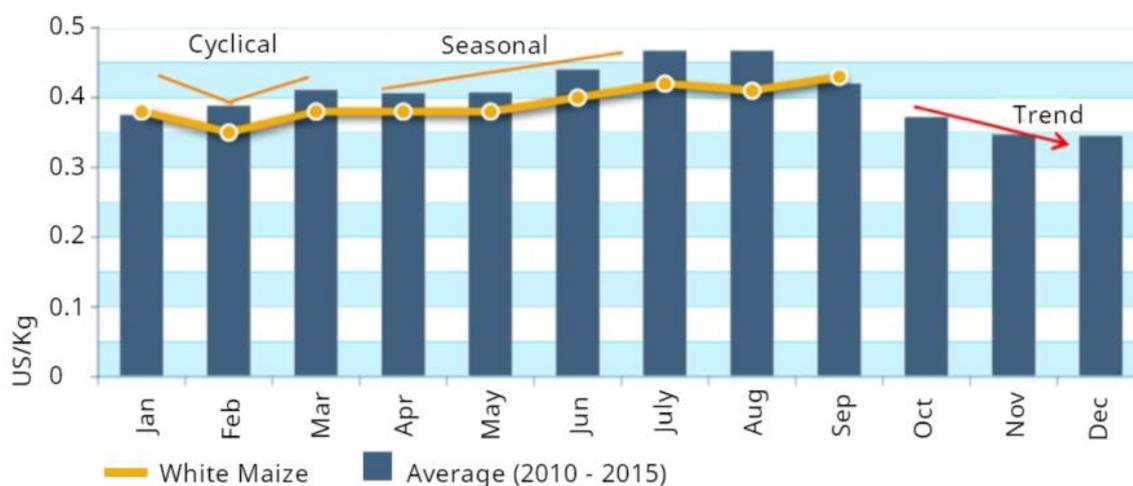
An answer to these questions can be provided by examining the four basic components of time series data: Trend, Irregularity, Seasonal, Cyclical

> ℹ️ *Decomposition of a price series*

Each component of a price series may be plotted or saved separately. In addition, the decomposition can be used to create a seasonally adjusted version of the original time series. Seasonal subseries and annual subseries may also be plotted. An analysis of price series always assumes that the value of the variable, at that time period, is equal to the sum of the four components and is represented by:

$$Y_t = T_t + S_t + C_t + R_t$$

Where:

Y_t = Original data T_t = Trend value

S_t = Seasonal fluctuation C_t = Cyclical fluctuation

R_t = Irregular fluctuation

Can seasonal fluctuations be identified? **The seasonal component of a time series**
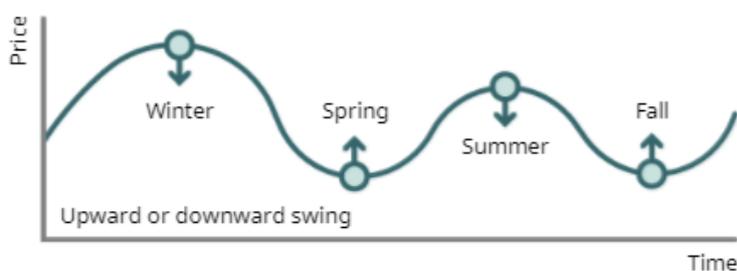
A seasonal effect is a **systematic and calendar related effect**. Seasonal variations are reasonably stable with respect to timing, direction and magnitude. The seasonal component arises from systematic, calendar related influences such as:

Natural conditions, for instance, weather fluctuations that are representative of the season.

Business procedures, for example, the beginning and end of the school term or public sector working days.

Social and cultural behaviour, for instance, dates of religious festivals. In countries that celebrate Christmas, retail sales are higher in November and December.

Trading day effects, the trading day effect is the part of the movements in the time series that is caused by a different number of weekdays in calendar periods (months or quarters, respectively).

Trend

Can a trend be defined? **Trend component of a time series**

A trend can be positive or negative, depending on whether the time series exhibits an **increasing** long-term pattern or a **decreasing** long-term pattern. If a time series does not show an increasing or decreasing pattern, then the series is stationary in the mean. Trends can be:
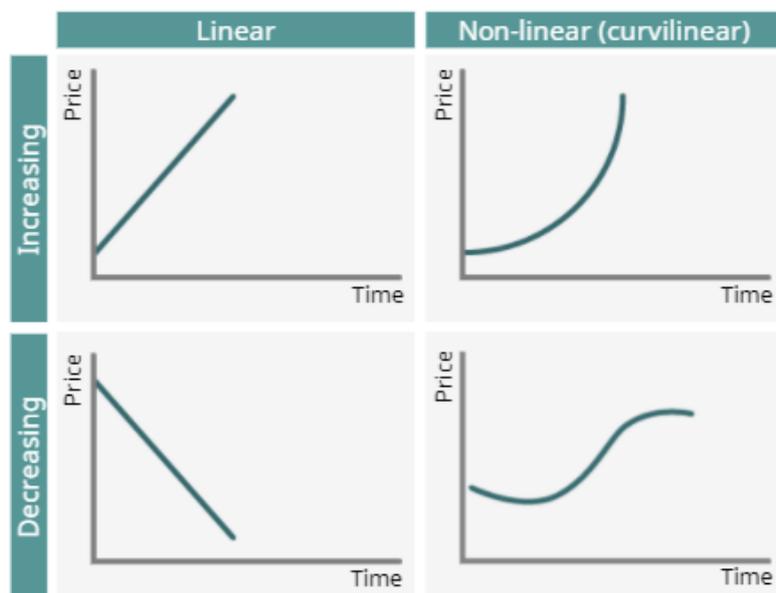
> ### Nominal and real values
>
> In any long series of prices, inflation can be a concern. If the price analysis involves any kind of comparison of prices or price changes across long spans of time, a **price deflator should be used** to put values at different dates into comparable real terms.
>
> Inflation is the phenomenon that explains why 10 euros today will not buy as much as 10 euros did years ago. Inflation is a special kind of trend that is dealt with by 'deflating' the price series by an inflation index.
>
> - the **nominal data series** - The nominal data series is simply the data measured in current value (nominal value) and gathered by a government or private survey;
>
> - an **appropriate price index** - Among the more prominent price indexes are the Consumer Price Index (CPI), the Producer Price Index (PPI), the Personal Consumption Expenditure index (PCE) and the GDP (Gross Domestic Product) deflator. Common price indexes measure the value of a basket of goods in a certain time period, relative to the value of the same basket in a base period.

> The formula for obtaining a real series is given by dividing nominal values by the price index (decimal form) for that same time period:
>
> **Nominal value - Price index (decimal form) = Real value**

Cyclical component

Are there phases of expansion and contraction? **Cyclical component of a time series**

Sometimes series exhibit oscillations which do not have a fixed period, but are predictable to some extent. This variation is defined as a cyclical variation, a non-seasonal component which varies in a recognizable cycle. Cycles can last much longer than one year and are not as predictable as the seasonal component because neither the timing nor the effect on prices is known exactly.
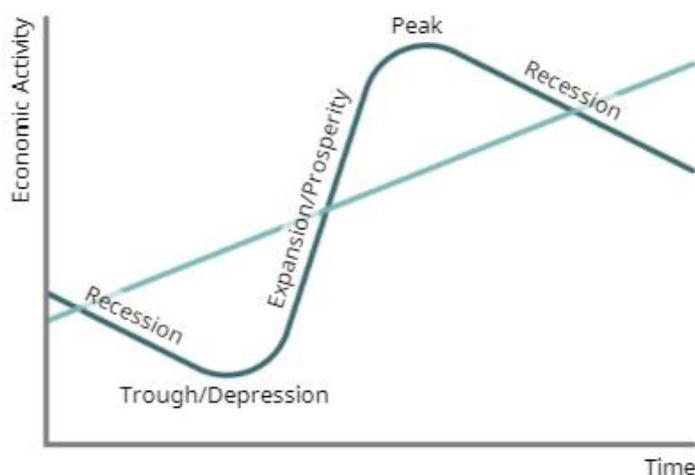
A cyclical variation is periodic in nature and repeats itself like a business cycle, which has **four phases**: peak, recession, trough/depression, expansion/prosperity.

For example, in a recession, employment, production and many other business and economic series are below the long-term trend lines. Conversely, in periods of prosperity, they are above their long-term trend lines.

Irregular component

Is there regularity in data variations? **Irregular component of a time series**

The irregular component (sometimes also known as the residual) is what remains after the seasonal and trend components of a time series have been estimated and removed. It results from **short-term fluctuations** in the series that are **neither systematic nor predictable**. In a highly irregular series, these fluctuations can dominate movements, which will mask the trend and seasonality. Irregular fluctuations, often called chance fluctuations, are unpredictable, and they cannot be identified. Of course, neither episodic nor residual variations can be projected into the future.

Irregular variation occurs due to sudden causes and is called residual variation (irregular variations or accidental or erratic fluctuations) and are unpredictable, for example, a rise in prices of oil due to a strike, earthquake, war etc…

Time series plot of white maize (Mexico)
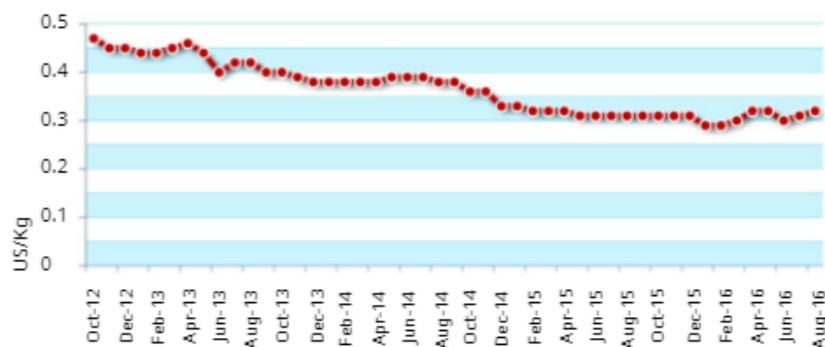
Irregular variations are fluctuations in time series that are **short in duration**, **erratic in nature** and **follow no regularity** in occurrence (random).

Example: time series components
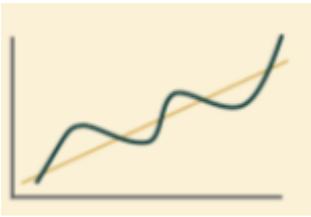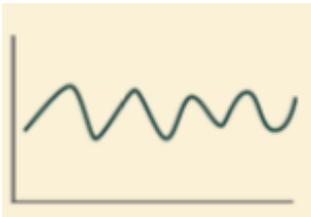
Trend   Cyclical component   Irregular component
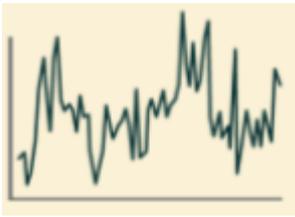
The first diagram shows a linear increasing trend. Diagram 2 shows a cyclical variation. Graphic 3 shows no consistent trend and no seasonality, but presents short-term fluctuations in the series that are neither systematic nor predictable (irregular variation).

Markets and prices

Supply and demand, sellers and consumers interact in markets. It is in real or virtual markets that we need to observe price determination and understand how market functioning and characteristics may affect prices at domestic and international level.

Let's see how prices and markets are interrelated, beginning with the definition of a **market[3]**. For example, let's observe the price of a commodity or product in one market, a local market. How will prices in this market affect or be affected by prices in other markets? This depends on **market integration**, which refers to how changes in prices in one market get transmitted to neighboring markets.

Market integration

The classical paradigm of market integration is known as the **law of one price** (**LOOP**)[4].

Let's suppose we are observing the equilibrium price of a food commodity on two markets.

If markets are integrated, equilibrium prices of the same commodity on competitive foreign and domestic markets differ only by transfer costs, when converted to a common currency.

Types of market integration

"Integration is taken to denote a state of affairs or a process involving attempts to combine separate national economies into larger economic regions." (*Source: Robson, 1987*). "Market integration is defined as the degree of price transmission between two, either vertically or spatially, related markets." (*Source: Pratap Kumar, 2016*). There are three basics kinds of market integration:

Horizontal integration

This occurs when a firm or agency gains control of other firms or agencies performing similar marketing functions at the same level in the marketing sequence. These firms or agencies combine to form a union with a view to reducing their effective number, and the extent of actual competition in the market. It is advantageous for the members who join the group.

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[3] Market is a set of individuals and/or organizations (market participants) exchanging goods or services, or all the transactions between those entities. A marketplace can be physical or virtual.

[4] **Law of one price (LOOP)** Identical products are sold at a uniform price across different markets. Market integration is a removal of barriers between two markets for the same product, so that **prices on the two markets become more closely linked**.

Vertical integration

This occurs when a firm performs more than one activity in the sequence of the marketing process. It is a linking together of two or more functions in the marketing process within a single firm or under a single ownership. This type of integration makes it possible to exercise control over both quality and quantity of the product during the whole production process.

Conglomeration

A combination of agencies or activities not directly related to each other may be termed a conglomeration, when they operate under a unified management. For example, chemical conglomerates are companies originally specialized in material science - chemical and polymer business that changed the focus to life sciences - pharmaceuticals and agriculture.

Market integration is a removal of barriers between two markets for the same product, so that prices on the two markets become more closely linked.

How market integration affects prices

Market integration is an indicator of the degree to which **different markets are related to each other**. Market integration may happen due to different factors, such as shifts in demand and supply, or government strategies.
For example, a drought in one area causes grain prices increase. This leads suppliers from other unaffected areas to try to supply grain to the affected area, so that they can benefit

This should occur in an integrated market as long as the price difference is greater than the costs of transporting and selling the item in a different market. Market integration is affected by the availability of information between markets, the existence of marketing networks, physical obstacles to trade such as poor infrastructure or conflict, and market regulation by government.

What is price transmission?

Market integration is strictly interconnected with **price transmission**. Price transmission refers to the **degree of ease with which price information is transferred and communicated among different markets** and market participants over geographic space and time. Generally, price transmission is

measured in terms of the transmission elasticity, defined as the percentage change in the price in one market, given a 1 percent change in the price in another market.

Factors affecting price transmission

Price transmission from world markets to domestic markets is affected by several factors, including:

- **Transport and input costs**: High transport costs and other marketing costs, when substantial, cause a rise in world prices to be under-reflected in import parity prices, and over-reflected in export parity prices.

- **Countries' levels of self-sufficiency**: In countries that are largely self-sufficient and not well integrated into international markets, due to high transportation and transactions costs, domestic prices move independently of world prices.

- **Exchange rates**: For example, a depreciation of the US dollar against other currencies means that the world price of a commodity denominated in US dollars declines in terms of those other currencies. This lower price in other currencies increases the demand and reduces the supply from the countries involved, which might increase the price denominated in US dollars.

- **Lack of information about prices in other markets**: Current information on domestic and global agriculture shapes expectations about future prices and allows markets to function more efficiently. A lack of accurate information on market fundamentals might accentuate price movements and affect price transmission.

- **Domestic shocks**: As international food prices reflect global scarcity or surplus, their transmission to domestic prices can help to improve the global responsiveness of the food system to shocks.

- **Trade policy**: Trade policy is perhaps the most fundamental determinant of the extent to which world price shocks pass through to domestic markets. The key factor that affects price transmission is the degree to which the government determines the volume of trade (either exports or imports). For instance, government control might be applied formally through a fixed quota, or informally, through ad-hoc determination of quotas that vary in response to external events.

Types of price transmission

We usually distinguish the following types of price transmission:

Spatial price transmission: Occurs when a commodity is heavily traded between two regions or countries. For example, maize prices in the exporting country strongly affect maize prices in the importing country.

Cross-commodity price transmission: If maize prices rise, some consumers are willing to shift to purchasing rice in greater than usual quantities. This increased demand will drive up the price of rice. Consequently, an increment in the maize price might also increase the price of rice.

Vertical price transmission: Occurs when the price of a good increases due to the rising price of one of the inputs used to make it. For example, if the price of wheat rises, millers will increase the price of their flour. And further up the chain, bakers may raise the price of bread, in order to compensate for the higher price of flour.

Price transmission analysis

Price transmission analysis can provide interesting information, as shown in the example discussed here. Let's suppose there has been a sharp increase in wood product prices in global markets. This may constitute, at the same time, both an **important opportunity** and a **challenge** for domestic economies, depending also on how integrated domestic markets are with world markets and among each other.

Important opportunity

A sharp increase in prices presents an important opportunity for an economy, but the degree to which producers can profit from it depends on how integrated **domestic markets are with world markets**. That is, on how closely domestic prices move in alignment with world prices.

Missed opportunity

On the other hand, the degree to which producers can profit from the opportunity offered by a global price increase depends on how **integrated the different provincial markets are with each other**. Weak integration implies weak domestic supply responses to higher commodity prices. Incomplete price transmission results in a reduction in the price information available to economic agents. They will be unable to make the best possible decisions, and this will lead to an inefficient outcome.

Price transmission analysis measures the effect of prices in one market on prices in another market.

Scenarios

Country A - This country, a strong meat (especially beef) producer, has removed barriers to the meat trade. Due to an increase in supply, beef prices decrease on international markets.

Country B - The main cities of this country rely on food provisions from the surrounding agricultural regions. Last year, the maize harvest was above average in almost all the agricultural areas.

Effects on prices these events may have.

Country A	Country B
Beef prices fall on international markets.	The maize harvest is above average in almost all the country's agricultural areas.
Local pork prices increase.	Local maize prices fall.
Local beef prices increase.	Maize surplus is exported to the main cities, leading to a fall in maize prices there.

If there is a relationship between international prices and the local price or between local prices for the same commodity in different regions, price transmission analysis will allow to know how quickly we can expect prices to react to a change. This is what we can observe in the scenario of country B. In addition, markets are not related only between regions but also between commodities. Hence, shocks to one of the markets will get transmitted to another if markets are integrated, as in the scenario of Country A.

How prices are determined on markets and how market integration affects price transmission?

IN DEPTH: MARKET INTEGRATION

Market integration is a removal of barriers between two markets for the same products, so that prices on the two markets become more closely linked.

The commodity markets around the world have been integrated within as well as across boundaries. At the same time, deregulation in the market has led to removal of trade restrictions, which is one of the pre-requisites for market integration. Commodities are now more mobile across national boundaries with the development of technologies and communication systems. The degree of market integration is the degree to which changes in market conditions in one market affect those in other markets (separated by time or space). Generally:

high degree of integration	*low degree of integration*
There are low barriers to trade.	There are high barriers to trade.
Prices are similar in these markets.	Prices fluctuate between these markets.

Market agents are able to interact between different markets.

There are different forms of market integration

➥ **Preferential Agreement**

It involves **lower trade barriers** and preferential access for imports.

The Europe Agreements grant some Central and Eastern European countries easier access to European Union (EU) markets.

➥ **Free Trade Area**

This **removes barriers to trade** among member countries, but each member country still has autonomy in deciding on the external rate of tariff for its trade with non-member countries.

EFTA (European Free Trade Area) and CEFTA (Central European Free Trade Area) are examples of Free Trade Areas.

➥ **Customs Union**

Members not only remove all barriers to trade among themselves but also adopt a common tariff against imports from non-member countries.

Until the end of 1992, the European Community was basically a Customs Union.

➥ **Common Market**

This goes beyond a Customs Union in **allowing free movement of labour and capital** within the Union. The Single Market of the European Union, which came into force on January 1, 1993, constitutes a Common Market.

➥ **Economic Union**

In addition to the conditions of a Common Market, member countries also agree to integrate monetary, fiscal and other policies, including foreign and defense policy.

The European Union is an example of an economic union.

There are many reasons for market integration. Market integration:

Enables a reduction in transaction costs: Transaction costs can be classified as:

• Information costs (price information, market location, etc.).

• Negotiation costs (negotiating terms of exchange, drawing up the contract, etc.).

• Monitoring and enforcement costs (payment arrangements). (*Source: Hobbs, 1997*)

Market integration must achieve savings in transaction costs. Without integration, diversity in legal rules might create trade barriers that prohibit agents from using some production and marketing techniques in larger areas.

Fosters competition: An integration of markets might not guarantee competitive results, but market integration increases their likelihood, since firms that are dominant in one market now face competitors, who may themselves be dominant in their respective market area. An increment of the number of competitors constrains the exercise of market power and reduces the likelihood of anti-competitive behaviour.

Provides better signals for optimal consumption decisions and consumption risk sharing
Effective competition in integrated markets directly benefits consumers by increasing consumer surplus through lower prices. It also benefits firms by protecting competitors against the abuse of market power by dominant companies. In addition, market integration provides better signals for consumption risk sharing (i.e. the idea that agents - families or countries - attempt to insure their consumption streams against individual income fluctuations). At the individual agent level, unemployment or medical insurance schemes, welfare and social government programmes or even intergenerational transfers may help to reduce the effect of individual specific shocks and catastrophic, idiosyncratic income fluctuations.

Improves security of supply For instance, when a power plant fails or during extreme weather conditions, Member States need to be able to rely on their neighbours to import the electricity they need.

Price volatility

In this final part of the lesson let's examine price volatility[5].

This is the price series related to a specific crop within a specific period of time.

This curve represents the **volatility of this price series**, that is prices movement up or down over a given period of time. That movement can be close to zero (low volatility) or several degrees of magnitude greater (high volatility).

Agricultural prices vary because production **supply** and consumption **demand** are variable. There are two types of variability: predictable and unpredictable, the latter being characterized in terms of **shocks**.

Production can vary either because of variations in area planted or because of yield variations, typically due to weather. **Consumption** varies because of changes in incomes, prices of substitutes, and shifts in tastes. It is generally supposed that the most important source of price variability in agriculture is **weather shocks to agricultural yields**.

Source: Gilbert and Morgan, 2010 http://rstb.royalsocietypublishing.org/content/365/1554/3023

Different factors affect price volatility:

A decline in the elasticity of demand and/or supply

The extent to which given production and consumption shocks translate into price volatility depends on supply and demand elasticity. In agricultural commodity markets, demand elasticity is relatively small with respect to price. Supply elasticity is also low, at least in the short run. In order to get

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[5] Price volatility is often defined as the variability of price series around its central value i.e. the tendency for individual price observations to vary significantly from their mean value.

supply and demand back into balance after a supply shock, **prices have to vary** quite **strongly**, especially in the case of low price volatility.

An increase in the variance of demand and/or supply shocks

Food price volatility arises from shocks that can come from a number of sources,

with the impact being felt differently in each separate commodity. These shocks are also often correlated. Such shocks include demand in growth, high oil prices generating demand for grains as biofuel feedstocks, dollar depreciation and futures market speculation, among others.

Interventions to reduce price volatility

On the other hand, a series of policy interventions may reduce price volatility and address high prices. These include:

↳ Improving market information

Information on the current situation and outlook for global agriculture shapes expectations about future prices, and allows markets to function more efficiently. Efforts such as Famine Early Warning Systems have increased the availability of information to governments and market participants. Monitoring food prices is also crucial for policy-making and designing effective risk management instruments for developing countries.

↳ Stockholding

Stockholding might reduce volatility as long as stocks are accumulated in periods of excess supply and released in times of excess demand. Moreover, stockholding is more effective in reducing the extent of price falls in the event of abundant harvests than in reducing the extent of price rises in the event of shortfalls, since destocking depends on the existence of a carryover from previous years.

↳ Agricultural trade policies

Trade restrictions such as market and transportation infrastructure, and the capacity to meet sanitary and phytosanitary requirements, have an impact on the capacity of a country to export. Initiatives such as Aid for Trade being implemented by the World Trade Organization and the Organization for Economic Cooperation and Development are helping to overcome some of these domestic barriers to trade.

Regarding export restrictions, many nations have committed to make humanitarian exemptions, first, at the G8 Summit in L'Aquila, Italy in July 2009, and then at the World Summit on Food Security in Rome in November 2009, where all FAO member states agreed to "remove food export restrictions or extraordinary taxes for food purchased for non-commercial humanitarian purposes (…)".

✎ **Coping mechanisms**

These can be either before (*ex ante*) or after (*ex post*) the fact. For instance, farmers face both production risks and price risks. A prudent risk management strategy must consider both sources of risk. In addition, technologies such as the introduction of disease resistant, or stress resistant varieties, or the construction of irrigation and drainage systems might reduce the risk to which farmers are exposed. Finally, interventions can occur at either international or domestic level, and can be implemented by either the public or the private sector (S*ource: FAO, 2011 www.fao.org/3/a-an794e.pdf).* For example, a number of Asian rice producing countries have long histories of successful stabilization of domestic rice prices, using a combination of import and/or export levies, as well as food reserve stockpiles. (S*ource: Dawe and Timmer).*

✎ **Stabilization**

Many governments in the Global South act to stabilize the domestic prices of food staples in order to avoid importing volatility from the world market. This is often the case when those countries are also significant producers of the food staples. Stabilization might limit the incentive for domestic farmers to respond to signals from the world market. However, the risk is that, if a sufficient number of countries act in this way, the resulting reduction in the world supply elasticity will exacerbate volatility.

What is price level?

Price level[6] and price volatility are the final topics that we will examine.

How to measure the price level

The **Consumer Price Index** (**CPI**) captures the broad pattern of price level changes faced by households over the long term. However, over shorter horizons, the trend in price change may be masked by one-off events, such as supply disturbances and seasonality, which can induce volatile short-term price behaviour. The CPI uses the typical purchases of households as the bundle of goods. To provide an indication of the trend in CPI over time, alternative statistics can be calculated which filter some of the short-term disturbances that may affect it. These, which are also known as trend

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[6] **Price level -** the **average of current prices** across the entire spectrum of goods and services produced in an economy. In a more general sense, price level refers to any static picture of the price of a given good, service or tradable security. Price levels may be expressed in small ranges, such as ticks with securities prices, or presented as a discrete value.

measures of price level change, isolate the more persistent component of general price level changes.

CPI= $\dfrac{\text{base year basket quantities multiplied by current year prices}}{\text{base year basket quantities multiplied by base year prices}}$ X 100

By additionally using the statistics on Gross Domestic Product (GDP) real and nominal GDP, one can calculate an implicit index of the price level for the year. This index is called the GDP deflator and is given by the formula:

GDP deflator= $\dfrac{\text{Nominal GDP}}{\text{Real GDP}}$ X 100

Example

The **FAO Food Price Index** is a measure of the monthly change in international prices of a basket of food commodities. It consists of the average of five commodity group price indices, weighted with the average export shares of each of the groups for 2002-2004.
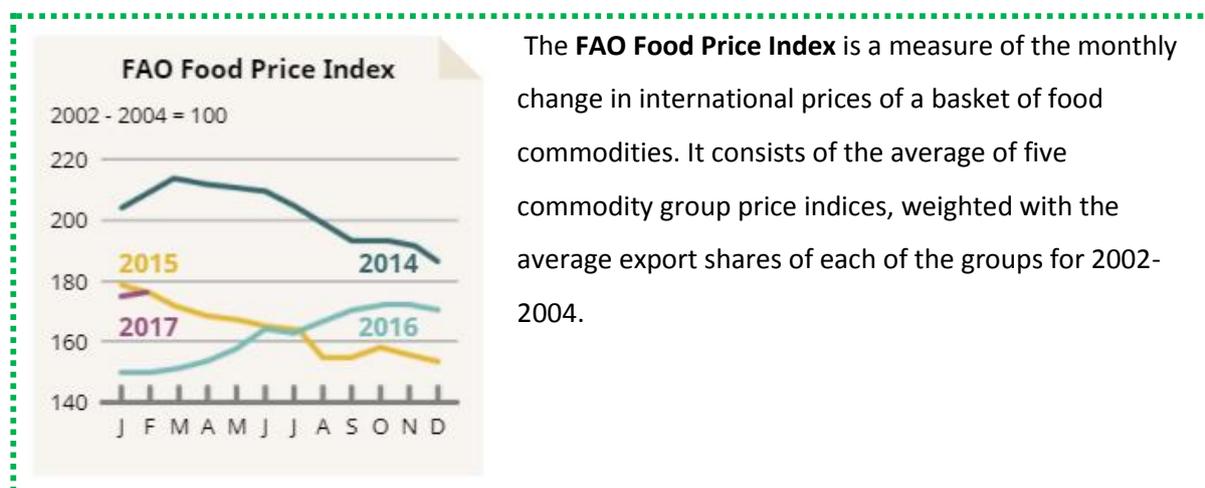
Inflation is the growth or increase, on average, of price. The **annual rate of inflation** is the year-to-year percentage growth of the price level.

What determines price level

The **price level** is the average of all prices in an economy, taken as a percentage of that same average in some earlier base period. According to the Ratio Theory of Price level, in mathematical terms, the price level is a ratio:

$P = \dfrac{V_G}{V_M}$ The market value of the basket of goods (the numerator) divided by the market value of money (the denominator). The market value of goods (V_G) and the market value of money (V_M) are both measured in terms of a standard unit used or the measurement of market value. This standard unit is a "theoretical" measure of market value and is invariable in the property of market value.

Numerator

All else remaining equal, **as the market value of goods rises**, **the price level rises**.

The market value of the basket of goods can rise due to a sudden increase in aggregate demand or a sudden decrease in aggregate supply, for instance, due to a supply shock.

Denominator

The denominator is the market value of money: all else remaining equal, as **the market value of money falls**, **the price level rises**.

Price volatility and price level

Price levels and price volatility are related, as they are both determined by supply and demand. Price levels affect producers' profits and their incentives to produce, as well as food costs to consumers, and consequently their purchasing decisions and economic access to food. Price level affects demand and supply differently on the basis of the time period considered.

Short run

In the short run, high food prices benefit producers, and low food prices help consumers.

Medium to long run

In the medium to long term, high food prices may positively affect even net food buyers, if higher food prices generate dynamic economic processes that raise employment rates and/or wages, in both rural and urban areas, by amounts that more than compensate for the greater cost of food. In conclusion, prices can be high but stable.

Price volatility differs from the price level, since it **generates uncertainties** about the true price level for producers and consumers. Due to uncertainty, **production and consumption** decisions may lead to suboptimal outcomes compared with those achieved under more stable price conditions. Additionally, on the **production side**, price volatility may reduce investments and cause production to shift toward lower risk, less productive technologies, with negative macroeconomic impacts. *Source: Díaz Bonilla, 2016*.

This is the cycle:

Initially, high prices encourage people to draw down their stocks.

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This can moderate price changes that would otherwise have been caused by supply and demand shocks. However…

… Once stocks have been drawn down, the system is vulnerable to further shocks, and price variation will tend to be greater than if stocks were available.

Summary

The demand of a good represents the behaviour of households or consumers, and represents the willingness and ability of consumers to purchase a good. The supply is the amount of goods/commodities that sellers are willing to sell at a particular market price. The interaction between supply and demand determines price. Price variations, gradual or sudden (shocks), cause changes along the curves, while changes in other determinants cause shifts in the curves, leading to price increases and decreases.

Prices can be observed during a time period. In a time series, it is possible to identify different components: seasonal, cyclical, trend and irregular.

Prices can remain high or low, but stable, or they can fluctuate around their mean. Price volatility is the variability of price series around its central value. Price volatility should not be confused with price level.

The price level is the average of all prices in an economy, taken as a percentage of that same average in some earlier base period. Price volatility does not necessarily mean that prices are high. Prices can be high, but stable.

Prices are determined on markets. The removal of barriers to commodities circulation is defined as market integration, an indicator that explains how much different markets are related to each other. Markets are integrated if prices among different locations move in similar patterns, given that the differences between prices is explained by transfer and transaction costs, as goods or products flow between locations. Otherwise, markets are segmented. Markets may be segmented, for instance, as a result of prohibitive transaction costs related to poor infrastructure in remote areas, or damaged infrastructure.