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**MATHEMATICS FOR BUSINESS AND ECONOMICS**  
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## **Mathematics for business and economics**

This is one topic strategic to the development of any business organization and below is some the selected definitions:

- The quantitative examination of economic trends and relationships using statistical techniques, and the development, examination, and refinement of those techniques.
- The application of statistical tools and techniques to economic issues and economic data.
- The application of statistical methods to the empirical estimation of economic relationships. Econometric analysis is used extensively in international economics to estimate the causes and effects of international trade, exchange rates, and international capital movements.

Creation of mathematical models describing economic relationships...

- Mathematical computerized models used to illustrate the relationship between key economic conditions such as employment rates, interest rates, and government policies. It is then used to conduct analyses on various economic situations. An econometric model, for example, might be used to show the relationship between consumer spending and unemployment rates.
- The application of mathematics in testing economic theories.
- Application of mathematical and statistical techniques to economics in the study of problems, the analysis of data, and the development and testing of theories and models.
- The application of mathematics and statistics to the study of economic and financial data

### **Econometrics**

Econometrics literally means economic measurement. It is a combination of mathematical economics, statistics, economic statistics and economic theory. Econometrics literally means economical measurement though the grammatically correct term from Greek would be economometrics, the word has been shortened in English. Econometricians are concerned with the tasks of developing and applying quantitative or statistical methods to the study and elucidation of economics principles. Econometrics is derived from mathematical economics, statistics, statistical economics, and economics theory

The two main purposes of econometrics are to give empirical content to economic theory and to subject economic theory to potentially falsifying tests. For example, economic theory hypothesizes that a person with more education will on average earn more income

than person with less education holding everything else equal. Econometric estimates can estimate the magnitude and statistical significance of the relation.

The most important statistical method in econometrics is regression analysis. For an overview of a linear implementation of this framework, Regression methods are important in econometrics because economists typically cannot use controlled experiments. Observational data may be subject to omitted-variable bias and other problems which must be addressed statistically using regression models. Econometricians often seek illuminating natural experiments in the absence of evidence from controlled experiments.

Econometric analysis is divided into time series analysis and cross sectional analysis. Time series analysis examines variables over time, such as the effects of population growth on a nation's GDP. Cross sectional analysis examines the relationship between different variables at a point in time, for instance, the relationship between individual's income and food expenditures. When time series analysis and cross sectional analysis are conducted simultaneously on the same sample, it is called panel analysis. If the sample is different each time, it is called repeated cross section data. Multi-dimensional panel data analysis is conducted on data sets that have more than two dimensions. For example, some forecast data sets provide forecasts for multiple target periods, conducted by multiple forecasters, and made at multiple horizons. The three dimensions provide more information than can be gleaned from two dimensional panel data sets.

Econometric analysis may also be classified on the basis of the number of relationships modeled. Single equation methods model a single variable (the dependent variable) as a function of one or more explanatory variables. In many econometric contexts such single equation methods may not be able to recover estimates of causal relationships because either the dependent variable causes changes in one of the explanatory variables or because variables not included in the model cause both the dependent and at least one of the independent variables. Simultaneous equation methods have been developed as one means of addressing these problems. Many of these methods use variants of instrumental variables models to make estimates. Much larger econometric models are used in an attempt to explain or predict the behavior of national economies.

### **Micro economics**

Microeconomics is a branch of economics that studies how individuals, households, and firms make decisions to allocate limited resources, typically in markets where goods or services are being bought and sold. Microeconomics examines how these decisions and behaviors affect the supply and demand for goods and services, which determines prices, and how prices, in turn, determine the supply and demand of goods and services.

One of the goals of microeconomics is to analyze market mechanisms that establish relative prices amongst goods and services and allocation of limited resources amongst many alternative uses. Microeconomics analyzes market failure, where markets fail to produce efficient results, as well as describing the theoretical conditions needed for perfect competition. Significant fields of study in microeconomics include markets under

asymmetric information, choice under uncertainty and economic applications of game theory. Also considered is the elasticity of products within the market system.

The theory of supply and demand usually assumes that markets are perfectly competitive. This implies that there are many buyers and sellers in the market and none of them have the capacity to significantly influence prices of goods and services. In many real life transactions, the assumption fails because some individual buyers or sellers or groups of buyers or sellers do have the ability to influence prices. Quite often a sophisticated analysis is required to understand the demand supply equation of a good. However, the theory works well in simple situations.

Mainstream economics does not assume a priori that markets are preferable to other forms of social organization. In fact, much analysis is devoted to cases where so called market failures lead to resource allocation that is sub optimal by some standard. In such cases, economists may attempt to find policies that will avoid waste directly by government control, indirectly by regulation that induces market participants to act in a manner consistent with optimal welfare, or by creating missing markets to enable efficient trading where none had previously existed. This is studied in the field of collective action.

The demand for various commodities by individuals is generally thought of as the outcome of a utility maximizing process. The interpretation of this relationship between price and quantity demanded of a given good is that, given all the other goods and constraints, this set of choices is that one which makes the consumer happiest.

It is assumed that all firms are following rational decision making, and will produce at the profit maximizing output. Given this assumption, there are four categories in which a firm's profit may be considered.

- A firm is said to be making an economic profit when its average total cost is less than the price of each additional product at the profit maximizing output. The economic profit is equal to the quantity output multiplied by the difference between the average total cost and the price.
- A firm is said to be making a normal profit when its economic profit equals zero, this occurs where price at the profit maximizing output average total cost equals.
- If the price is between average total cost and average variable cost at the profit maximizing output, then the firm is said to be in a loss minimizing condition. The firm should still continue to produce, however, since its loss would be larger if it were to stop producing. By continuing production, the firm can offset its variable cost and at least part of its fixed cost, but by stopping completely it would lose the entirety of its fixed cost.
- If the price is below average variable cost at the profit maximizing output, the firm should go into shutdown. Losses are minimized by not producing at all, since any

production would not generate returns significant enough to offset any fixed cost and part of the variable cost. By not producing, the firm loses only its fixed cost. By losing this fixed cost the company faces a challenge. It must either exit the market or remain in the market and risk a complete loss.

In microeconomics, the term market failure does not mean that a given market has ceased functioning. Instead, a market failure is a situation in which a given market does not efficiently organize production or allocate goods and services to consumers. Economists normally apply the term to situations where the inefficiency is particularly dramatic, or when it is suggested that non market institutions would provide a more desirable result. On the other hand, in a political context, stakeholders may use the term market failure to refer to situations where market forces do not serve the public interest, a subjective assessment that is often made on social or moral grounds.

The four main types or causes of market failure are:

- Monopolies or other cases of abuse of market power where a single buyer or seller can exert significant influence over prices or output. Abuse of market power can be reduced by using antitrust regulations.
  
- Externalities, which occur in cases where the market does not take into account the impact of an economic activity on outsiders. There are positive externalities and negative externalities. Positive externalities occur in cases such as when a television program on family health improves the public's health. Negative externalities occur in cases such as when a company's processes pollute air or waterways. Negative externalities can be reduced by using government regulations, taxes, or subsidies, or by using property rights to force companies and individuals to take the impacts of their economic activity into account.
  
- Public goods such as national defense and public health initiatives such as draining mosquito breeding marshes. For example, if draining mosquito breeding marshes was left to the private market, far fewer marshes would probably be drained. To provide a good supply of public goods, nations typically use taxes that compel all residents to pay for these public goods.
  
- Cases where there is asymmetric information or uncertainty (information inefficiency). Information asymmetry occurs when one party to a transaction has more or better information than the other party. Typically it is the seller that knows more about the product than the buyer, but this is not always the case. Buyers in some markets have better information than the Sellers. For example, used car sales people may know whether a used car has been used as a delivery vehicle or taxi, information that may not be available to buyers. An example of a situation where the buyer may have better information than the seller would be an estate sale of a house, as required by a last will and testament. A real estate broker purchasing this house may have more information about the house than the family members of the deceased.

**Opportunity cost:** Although opportunity cost can be hard to quantify, the effect of opportunity cost is universal and very real on the individual level. In fact, this principle applies to all decisions, not just economic ones. Opportunity cost has been seen as the foundation of the marginal theory of value.

Opportunity cost is one way to measure the cost of something. Rather than merely identifying and adding the costs of a project, one may also identify the next best alternative way to spend the same amount of money. The forgone profit of this next best alternative is the opportunity cost of the original choice. A common example is a farmer that chooses to farm his land rather than rent it to neighbors, wherein the opportunity cost is the forgone profit from renting. In this case, the farmer may expect to generate more profit himself. Similarly, the opportunity cost of attending university is the lost wages a student could have earned in the workforce, rather than the cost of tuition, books, and other requisite items whose sum makes up the total cost of attendance. The opportunity cost of a vacation in the Bahamas might be the down payment money for a house.

Note that opportunity cost is not the sum of the available alternatives, but rather the benefit of the single, best alternative. Possible opportunity costs of the city's decision to build the hospital on its vacant land are the loss of the land for a sporting center, or the inability to use the land for a parking lot, or the money that could have been made from selling the land, or the loss of any of the various other possible uses, but not all of these in aggregate. The true opportunity cost would be the forgone profit of the most lucrative of those listed.

One question that arises here is how to assess the benefit of dissimilar alternatives. We must determine a dollar value associated with each alternative to facilitate comparison and assess opportunity cost, which may be more or less difficult depending on the things we are trying to compare. For example, many decisions involve environmental impacts whose dollar value is difficult to assess because of scientific uncertainty. Valuing a human life or the economic impact of an Arctic oil spill involves making subjective choices with ethical implications.

**Applied micro economics:** Applied microeconomics includes a range of specialized areas of study, many of which draw on methods from other fields. Industrial organization and regulation examines topics such as the entry and exit of firms, innovation, and role of trademarks. Law and economics applies microeconomic principles to the selection and enforcement of competing legal regimes and their relative efficiencies. Labor economics examines wages, employment, and labor market dynamics. Public finance (also called public economics) examines the design of government tax and expenditure policies and economic effects of these policies (e.g., social insurance programs). Political economy examines the role of political institutions in determining policy outcomes. Health economics examines the organization of health care systems, including the role of the health care workforce and health insurance programs. Urban economics, which examines the challenges faced by cities, such as are sprawl, air and water pollution, traffic

congestion, and poverty, draws on the fields of urban geography and sociology. The field of financial economics examines topics such as the structure of optimal portfolios, the rate of return to capital, econometric analysis of security returns, and corporate financial behavior. The field of economic history examines the evolution of the economy and economic institutions, using methods and techniques from the fields of economics, history, geography, sociology, psychology, and political science.

### **Macroeconomics**

Macroeconomics is a branch of economics that deals with the performance, structure, and behavior of the economy as a whole. Macroeconomists seek to understand the determinants of aggregate trends in the economy with particular focus on national income, unemployment, inflation, investment, and international trade. In contrast, microeconomics is primarily focused on the determination of prices and the role of prices in allocating scarce resources.

While macroeconomics is a broad field of study, there are two areas of research that are emblematic of the discipline:

The attempt to understand the causes and consequences of short run fluctuations in national income the business cycle, and the attempt to understand the determinants of long run economic growth increases in national income.

Macroeconomic models and their forecasts are used by both governments and large corporations to assist in the development and evaluation of economic policy and business strategy.

One of the challenges of economics has been a struggle to reconcile macroeconomic and microeconomic models. Starting in the 1950s, macroeconomists developed micro based models of macroeconomic behavior (such as the consumption function). Dutch economist Jan Tinbergen developed the first comprehensive national macroeconomic model, which he first built for the Netherlands and later applied to the United States and the United Kingdom after World War II.

Theorists such as Robert Lucas Jr suggested in the 1970s that at least some traditional Keynesian macroeconomic models were questionable as they were not derived from assumptions about individual behavior, but instead based on observed past correlations between macroeconomic variables. However, New Keynesian macroeconomics has generally presented microeconomic models to shore up their macroeconomic theorizing, and some keynesians have contested the idea that microeconomic foundations are essential, if the model is analytically useful. An analogy might be, that the fact that quantum physics is not fully consistent with relativity theory does not mean that relativity is false. Many important microeconomic assumptions have never been proved, and some have proved wrong.

The various schools of thought are not always in direct competition with one another, even though they sometimes reach differing conclusions. Macroeconomics is an ever

evolving area of research. The goal of economic research is not to be right, but rather to be useful. An economic model should accurately reproduce observations beyond the data used to calibrate or fit the model. None of the current schools of economic thought perfectly capture the workings of the economy, however each approach contributes a unique perspective to the overall puzzle. As one learns more about each school of thought, it is possible to combine aspects of each in order to reach an informed synthesis.

### **Analytical approaches:**

The traditional distinction is between two different approaches to economics:

- Keynesian economics focuses on aggregate demand to explain levels of unemployment and the business cycle. That is, business cycle fluctuations should be reduced through fiscal policy the government spends more or less depending on the situation and monetary policy. Early Keynesian macroeconomics was activist, calling for regular use of policy to stabilize the capitalist economy, while some Keynesians called for the use of incomes policies.
  
- Supply-side economics delineates quite clearly the roles of monetary policy and fiscal policy. The focus for monetary policy should be purely on the price of money as determined by the supply of money and the demand for money. It advocates a monetary policy that directly targets the value of money and does not target interest rates at all. Typically the value of money is measured by reference to gold or some other reference. The focus of fiscal policy is to raise revenue for worthy government investments with a clear recognition of the impact that taxation has on domestic trade. It places heavy emphasis on Say's law, which states that recessions do not occur because of failure in demand or lack of money.

### **Schools:**

- Monetarism, led by Milton Friedman, holds that inflation is always and everywhere a monetary phenomenon. It rejects fiscal policy because it leads to crowding out of the private sector. Further, it does not wish to combat inflation or deflation by means of active demand management as in Keynesian economics, but by means of monetary policy rules, such as keeping the rate of growth of the money supply constant over time.
  
- New Keynesian economics, which developed partly in response to new classical economics, strives to provide microeconomic foundations to Keynesian economics by showing how imperfect markets can justify demand management.
  
- Austrian economics is a laissez faire school of macroeconomics. It focuses on the business cycle that arises from government or central bank interference that leads to deviations from the rate of interest, and emphasizes the importance of credit and investment misallocation in business cycle fluctuations.

- Post Keynesian economics represents a dissent from mainstream Keynesian economics, emphasizing the role of uncertainty, liquidity preference and the historical process in macroeconomics.
- New classical economics. The original theoretical impetus was the charge that Keynesian economics lacks microeconomic foundations i.e. its assertions are not founded in basic economic theory. This school emerged during the 1970s. This school asserts that it does not make sense to claim that the economy at any time might be out of equilibrium. Fluctuations in aggregate variables follow from the individuals in the society continuously re optimizing as new information on the state of the world is revealed. A neo classical economist would define macroeconomics as dynamic stochastic general equilibrium theory, which means that choices are made optimally considering time, uncertainty and all markets clearing.

### **Macroeconomic Policies**

In order to try to avoid major economic shocks, such as great depression, governments make adjustments through policy changes which they hope will succeed in stabilizing the economy. Governments believe that the success of these adjustments is necessary to maintain stability and continue growth. This economic management is achieved through two types of strategies.

- Fiscal Policy
- Monetary Policy

**Fiscal policy:** Fiscal policy is the economic term that defines the set of principles and decisions of a government in setting the level of public expenditure and how that expenditure is funded. Fiscal policy and monetary policy are the macroeconomic tools that governments have at their disposal to manage the economy. Fiscal policy is the deliberate and thought out change in government spending, government borrowing or taxes to stimulate or slow down the economy. It contrasts with monetary policy, which describes policies concerning the supply of money to the economy.

Fiscal policy is described as being neutral, expansionary, or contractionary. An expansionary fiscal policy occurs when the government lowers taxes and/or increases spending, thus expanding output national income. An increase in government spending or a cut in taxes shifts the aggregate demand curve to the right. An expansionary fiscal policy will expand the economy's growth. A contractionary fiscal policy occurs when the government raises taxes and/or lowers spending, thus lowering output national income. A decrease in government purchases or an increase in taxes shifts the aggregate demand curve to the left. A contractionary fiscal policy will constrict the economy's overall growth.

**Methods of raising funds:**

Governments spend money on a wide variety of things, from the military and police to services like education and healthcare, as well as transfer payments such as welfare benefits.

This expenditure can be funded in a number of different ways:

- Taxation
- Seignorage, the benefit from printing money
- Borrowing money from the population, resulting in a fiscal deficit.

Economic effects of fiscal policy:

Fiscal policy is used by governments to influence the level of aggregate demand in the economy, in an effort to achieve economic objectives of price stability, full employment and economic growth. Keynesian economics suggest that adjusting government spending and tax rates, are the best ways to stimulate aggregate demand. This can be used in times of recession or low economic activity as an essential tool in providing the framework for strong economic growth and working toward full employment. The government can implement these deficit spending policies due to its size and prestige and stimulate trade. In theory, these deficits would be repaid for by an expanded economy during the boom that would follow the basis for the new deal.

During periods of high economic growth, a budget surplus can be used to decrease activity in the economy. A budget surplus will be implemented in the economy if inflation is high, in order to achieve the objective of price stability. The removal of funds from the economy will, by Keynesian Theory, reduce levels of aggregate demand in the economy and contract it, bringing about price stability.

Despite the importance of fiscal policy, a paradox exists. In the case of a government running a budget deficit, funds will need to come from public borrowing the issue of government bonds, overseas borrowing or the printing of new money. When governments fund a deficit with the release of government bonds, an increase in interest rates across the market can occur. This is because government borrowing creates higher demand for credit in the financial markets, causing a higher aggregate demand due to the lack of disposable income, contrary to the objective of a budget deficit. This concept is called crowding out. Alternatively, governments may increase government spending by funding major construction projects. This can also cause crowding out because of the lost opportunity for a private investor to undertake the same project. However, the effects of crowding out are usually not as large as the increase in GDP stemming from increased government spending.

Another problem is the time lag between the implementation of the policy, and visible effects seen in the economy. It is often contended that when an expansionary fiscal policy is implemented, by way of decrease in taxes, or increased consumption keeping taxes at old level, it leads to increase in aggregate demand. However, an unchecked spiral in aggregate demand will lead to inflation. Hence, checks need to be kept in place.

**Monetary policy:** is the process by which the government, central bank, or monetary authority manages the money supply to achieve specific goals such as constraining inflation or deflation, maintaining an exchange rate, achieving full employment or economic growth. Usually the goal of monetary policy is to accommodate economic growth in an environment of stable prices. Monetary policy can involve changing certain

interest rates, either directly or indirectly through open market operations, setting reserve requirements, acting as a last resort lender or trading in foreign exchange markets.

Monetary policy is generally referred to as either being an expansionary policy, or a contractionary policy, where an expansionary policy increases the total supply of money in the economy, and a contractionary policy decreases the total money supply.

Expansionary policy is traditionally used to combat unemployment in a recession by lowering interest rates, while contractionary policy has the goal of raising interest rates to combat inflation or cool an otherwise overheated economy. Monetary policy should be contrasted with fiscal policy, which refers to government borrowing, spending and taxation.

Monetary policy rests on the relationship between the rates of interest in an economy, that is the price at which money can be borrowed, and the total supply of money. Monetary policy uses a variety of tools to control one or both of these, to influence outcomes like economic growth, inflation, exchange rates with other currencies and unemployment. Where currency is under a monopoly of issuance, or where there is a regulated system of issuing currency through banks which are tied to a central bank, the monetary authority has the ability to alter the money supply and thus influence the interest rate in order to achieve policy goals.

A policy is referred to as contractionary if it reduces the size of the money supply or raises the interest rate. An expansionary policy increases the size of the money supply, or decreases the interest rate. Further monetary policies are described as accommodative if the interest rate set by the central monetary authority is intended to spur economic growth, neutral if it is intended to neither spur growth nor combat inflation, or tight if intended to reduce inflation.

There are several monetary policy tools available to achieve these ends. Increasing interest rates by fiat, reducing the monetary base, and increasing reserve requirements all have the effect of contracting the money supply, and, if reversed, expand the money supply. Since the 1970s, monetary policy has generally been formed separately from fiscal policy.

Within almost all modern nations, special institutions such as the Bank of England, the European Central Bank or the Federal Reserve System in the United States exist which have the task of executing the monetary policy independently of the executive. In general, these institutions are called central banks and often have other responsibilities such as supervising the smooth operation of the financial system.

The primary tool of monetary policy is open market operations. This entails managing the quantity of money in circulation through the buying and selling of various credit instruments, foreign currencies or commodities. All of these purchases or sales result in more or less base currency entering or leaving market circulation.

Usually the short term goal of open market operations is to achieve a specific short term interest rate target. In other instances, however, monetary policy might instead entail the targeting of a specific exchange rate relative to some foreign currency or else relative to gold.

The advancement of monetary policy as an engineering discipline has been quite rapid in the last 150 years, and it has increased especially rapidly in the last 50 years. Monetary policy has grown from simply increasing the monetary supply enough to keep up with both population growth and economic activity. It must now take into account such diverse factors as:

- Short term interest rates.
- Long term interest rates.
- Velocity of money through the economy.
- Exchange rates.
- Credit quality.
- Bonds and equities (corporate ownership and debt).
- Government versus private sector spending/savings.
- International capital flows of money on large scales.
- Financial derivatives such as options, swaps, futures contracts.

The central bank influences interest rates by expanding or contracting the monetary base, which consists of currency in circulation and bank's reserves on deposit at the central bank. The primary way that the central bank can affect the monetary base is by open market operations or sales and purchases of second hand government debt, or by changing the reserve requirements. If the central bank wishes to lower interest rates, it purchases government debt, thereby increasing the amount of cash in circulation or crediting bank's reserve accounts. Alternatively, it can lower the interest rate on discounts or overdrafts, basically loans to banks secured by suitable collateral, specified by the central bank. If the interest rate on such transactions is sufficiently low, commercial banks can borrow from the central bank to meet reserve requirements and use the additional liquidity to expand their balance sheets, increasing the credit available to the economy. Lowering reserve requirements has a similar effect, freeing up funds for banks to increase loans or buy other profitable assets.

A central bank can only operate a truly independent monetary policy when the exchange rate is floating. If the exchange rate is pegged or managed in any way, the central bank will have to purchase or sell foreign exchange. These transactions in foreign exchange will have an effect on the monetary base analogous to open market purchases and sales of government debt; if the central bank buys foreign exchange, the monetary base expands, and vice versa. But even in the case of a pure floating exchange rate, central banks and monetary authorities can at best lean against the wind in a world where capital is mobile. Accordingly, the management of the exchange rate will influence domestic monetary conditions. In order to maintain its monetary policy target, the central bank will have to sterilize or offset its foreign exchange operations. For example, if a central bank buys foreign exchange to counteract appreciation of the exchange rate, base money will

increase. Therefore, to sterilize that increase, the central bank must also sell government debt to contract the monetary base by an equal amount. It follows that turbulent activity in foreign exchange markets can cause a central bank to lose control of domestic monetary policy when it is also managing the exchange rate.

In the 1980s, many economists began to believe that making a nation's central bank independent of the rest of executive government is the best way to ensure an optimal monetary policy, and those central banks which did not have independence began to gain it. This is to avoid overt manipulation of the tools of monetary policies to effect political goals, such as re electing the current government. Independence typically means that the members of the committee which conducts monetary policy have long, fixed terms. Obviously, this is a somewhat limited independence. Independence has not stunted a thriving crop of conspiracy theories about the true motives of a given action of monetary policy.

In the 1990s central banks began adopting formal, public inflation targets with the goal of making the outcomes, if not the process, of monetary policy more transparent. That is, a central bank may have an inflation target of 2% for a given year, and if inflation turns out to be 5%, then the central bank will typically have to submit an explanation.

Developing countries may have problems operating monetary policy effectively. The primary difficulty is that few developing countries have deep markets in government debt. The matter is further complicated by the difficulties in forecasting money demand and fiscal pressure to levy the inflation tax by expanding the monetary base rapidly. In general, central banks in developing countries have had a poor record in managing monetary policy.

However, recent attempts at liberalizing and reforming the financial markets particularly the recapitalization of banks and other financial institutions in Nigeria and elsewhere are gradually providing the leeway required to implement monetary policy frameworks by the relevant central banks.

### **Types of monetary policy:**

In practice all types of monetary policy involve modifying the amount of base currency (M0) in circulation. This process of changing the liquidity of base currency is called open market operations.

Constant market transactions by the monetary authority modify the liquidity of currency and this impacts other market variables such as short term interest rates, the exchange rate and the domestic price of spot market commodities such as gold. Open market operations are undertaken with the objective of stabilizing one of these market variables. The distinction between the various types of monetary policy lies primarily with the market variable that open market operations are used to target. Targeting being the process of achieving relative stability in the target variable.

The different types of policy are also called monetary regimes, in parallel to exchange rate regimes. A fixed exchange rate is also an exchange rate regime. The Gold standard results in a relatively fixed regime towards the currency of other countries on the gold standard and a floating regime towards those that are not. Targeting inflation, the price level or other monetary aggregates implies floating exchange rate unless the management of the relevant foreign currencies is tracking the exact same variables.

➤ Inflation targeting:

Under this policy approach the target is to keep inflation, under a particular definition such as Consumer Price Index, at a particular level. The inflation target is achieved through periodic adjustments to the Central Bank interest rate target. The interest rate used is generally the interbank rate at which banks lend to each other over night for cash flow purposes. Depending on the country this particular interest rate might be called the cash rate or something similar.

The interest rate target is maintained for a specific duration using open market operations. Typically the duration that the interest rate target is kept constant will vary between months and years. This interest rate target is usually reviewed on a monthly or quarterly basis by a policy committee.

Changes to the interest rate target are done in response to various market indicators in an attempt to forecast economic trends and in so doing keep the market on track towards achieving the defined inflation target.

➤ Price level targeting:

Price level targeting is similar to inflation targeting except that CPI growth in one year is offset in subsequent years such that over time the price level on aggregate does not move. Something like price level targeting was tried in the 1930s by Sweden, and seems to have contributed to the relatively good performance of the Swedish economy during the great depression. As of 2004, no country operates monetary policy based on a price level target.

➤ Monetary aggregates:

In the 1980s several countries used an approach based on a constant growth in the money supply. This approach was refined to include different classes of money and credit (M0, M1 etc). In the USA this approach to monetary policy was discontinued. This approach is also sometimes called monetarism. Whilst most monetary policy focuses on a price signal of one form or another this approach is focused on monetary quantities.

➤ Fixed exchange rate:

This policy is based on maintaining a fixed exchange rate with a foreign currency. Currency is bought and sold by the central bank on a daily basis to achieve the target exchange rate. This policy somewhat abdicates responsibility for monetary policy to a foreign government. This type of policy was used by China. The Chinese Yuan was managed such that its exchange rate with the United States dollar was fixed.

➤ Managed Float:

Officially, the Indian Rupee (INR) exchange rate is supposed to be market determined. In reality, the Reserve Bank of India (RBI) trades actively on the INR/USD with the purpose of controlling the volatility of the Rupee to US Dollar exchange rate within a narrow bandwidth. (I.e pegs it to the US Dollar)

Other rates like the INR/Pound or the INR/JPY have volatilities which reflect the volatilities of the US/Pound and the US/JPY respectively. The pegged exchange rate is accompanied by an elaborate system of capital controls.

On the current account, there are no currency conversion restrictions hindering buying or selling foreign exchange, though trade barriers do exist. On the capital account, foreign institutional investors have convertibility to bring money in and out of the country and buy securities which is subject to an elaborate maze of quantitative restrictions. Local firms are able to take capital out of the country in order to expand globally.

Local households have quantitative restrictions which are being relaxed in recent times in their ability to do global diversification. Most of these transactions happen through credit cards through the internet.

Owing to an enormous expansion of the current account and the capital account, India is increasingly moving into de facto convertibility. However, it still cannot be considered a fully convertible currency.

The INR is not a highly traded currency beyond India. It is traded by way of Forwards through inter bank transactions. Again the US Dollar exchange rate determines the INR / other Currencies exchange rate.

➤ Gold standard:

The gold standard is a system in which the price of the national currency as measured in units of gold is kept constant by the daily buying and selling of base currency. (i.e. open market operations).

The gold standard might be regarded as a special case of the Fixed Exchange Rate policy. And the gold price might be regarded as a special type of Commodity Price Index. Today this type of monetary policy is not used anywhere in the world, although a form of gold standard was used widely across the world prior to 1971.

Mixed policy:

In practice a mixed policy approach is most like inflation targeting. However some consideration is also given to other goals such as economic growth, unemployment and asset bubbles. This type of policy was used by the Federal Reserve in 1998.

**Monetary policy theory:**

It is important for policymakers to make credible announcements regarding their monetary policies. If private agents' consumers and firms believe that policymakers are committed to lowering inflation, they will anticipate future prices to be lower than otherwise how those expectations are formed is an entirely different matter compare for instance rational expectations with adaptive expectations). If an employee expects prices to be high in the future, he or she will draw up a wage contract with a high wage to match these prices. Hence, the expectation of lower wages is reflected in wage setting behavior between employees and employers lower wages since prices are expected to be lower and since wages are in fact lower there is no demands pull inflation because employees are receiving a smaller wage and there is no costs push inflation because employers are paying out less in wages.

However, to achieve this low level of inflation, policymakers must have credible announcements, that is, private agents must believe that these announcements will reflect actual future policy. If an announcement about low level inflation targets is made but not believed by private agents, wage setting will anticipate high level inflation and so wages will be higher and inflation will rise. A high wage will increase a consumer's demand pull inflation and a firm's costs cost push inflation, so inflation rises. Hence, if a policymaker's announcements regarding monetary policy are not credible, policy will not have the desired effect.

However, if policymakers believe that private agents anticipate low inflation, they have an incentive to adopt an expansionist monetary policy where the marginal benefit of increasing economic output outweighs the marginal cost of inflation. However, assuming private agents have rational expectations, they know that policymakers have this incentive. Hence, private agents know that if they anticipate low inflation, an expansionist policy will be adopted that causes a rise in inflation. Therefore, unless policymakers can make their announcement of low inflation credible, private agents expect high inflation. This anticipation is fulfilled through adaptive expectation wage setting behavior and so there is higher inflation without the benefit of increased output. Hence, unless credible announcements can be made, expansionary monetary policy will fail.

Announcements can be made credible in various ways. One is to establish an independent central bank with low inflation targets but no output targets. Hence, private agents know that inflation will be low because it is set by an independent body. Central banks can be given incentives to meet their targets, for example, larger budgets, a wage bonus for the head of the bank in order to increase their reputation and signal a strong commitment to a policy goal. Reputation is an important element in monetary policy implementation. But the idea of reputation should not be confused with commitment. While a central bank might have a favorable reputation due to good performance in conducting monetary policy, the same central bank might not have chosen any particular form of commitment such as targeting a certain range for inflation. Reputation plays a crucial role in determining how much markets would believe the announcement of a particular commitment to a policy goal but both concepts should not be assimilated. Also, note that

under rational expectations, it is not necessary for the policymaker to have established its reputation through past policy actions, example, the reputation of the head of the central bank might be derived entirely from her or his ideology, professional background, public statements. Hence the reputation of a particular central bank is not necessary tied to past performance, but rather to particular institutional arrangements that the markets can use to form inflation expectations.

### **Supply and Demand**

The supply and demand principle in economics is the main organizing idea of free market economics. Increased demand is communicated most effectively when buyers offer higher prices for goods and services. Suppliers generally respond by increasing supply, to take advantage of higher prices and make more money (higher profits). This is the supply side of the equation.

Increases in supply, however, tend to result in price competition. A supplier will typically lower his prices to make more sales, whenever he thinks this will result in higher profits when prices go down, this sends a signal to suppliers to lower supply.

The result of this interplay is generally an equilibrium in which prices are lower than before which satisfies buyers, and profits are higher than before which satisfies suppliers. Additional factors come into play, such as technological innovation (e.g. computer memory becomes cheaper because factories learn how to pack more megabytes into a chip). Some governments grant monopolies, or a successful company may corner a market. Centrally planned economies determine prices and supply schedules. The so called law of supply and demand therefore does not hold in all cases.

They describe market relations between prospective sellers and buyers of a good. The supply and demand model determines price and quantity sold in the market. The model is fundamental in microeconomic analysis of buyers and sellers and of their interactions in a market. It is also used as a point of departure for other economic models and theories. The model predicts that in a competitive free market, price will function to equalize the quantity demanded by consumers and the quantity supplied by producers, resulting in an economic equilibrium.

**Fundamental Concepts:** The model asserts that in a free market, the amount of a product supplied by the producer and the quantity demanded by the consumer are dependent on the market price of the product. The law of supply states that quantity supplied is directly proportional to price; the higher the price of the product, the more the producer will supply. The law of demand states that quantity demanded is inversely proportional to price, the higher the price of the product, the less the consumer will demand. The respective relations are called the supply curve and demand curve, or supply and demand.

The law of supply and demand states that the equilibrium market price of a commodity is at the intersection of consumer demand and producer supply. Here quantity supplied equals quantity demanded, that is, equilibrium. Equilibrium implies that price and

quantity will remain there if it begins there. If the price for a good is below equilibrium, consumers demand more of the good than producers are prepared to supply. This defines a shortage of the good. A shortage results in the price being bid up. Producers will increase the price until it reaches equilibrium. Conversely, if the price for a good is above equilibrium, there is a surplus of the good. Producers are motivated to eliminate the surplus by lowering the price. The price falls until it reaches equilibrium.

**Supply schedule:** The supply schedule is the relationship between the quantity of goods supplied by the producers of a good and the current market price. It is graphically represented by the supply curve. It is commonly represented as directly proportional to price. The positive slope in short-run analysis can reflect the law of diminishing marginal returns, which states that beyond some level of output, additional units of output require larger doses of the variable input. In the long run, a positively sloped supply curve can reflect diseconomies of scale or fixity of specialized resources.

For a given firm in a perfectly competitive industry, if it is more profitable to produce at all, profit is maximized by producing to where price is equal to the producer's marginal cost curve. Thus, the supply curve for the entire market can be expressed as the sum of the marginal cost curves of the individual producers.

Occasionally, supply curves do not slope upwards. A well known example is the backward bending supply curve of labour. Generally, as a worker's wage increases, he is willing to supply a greater amount of labor working more hours, since the higher wage increases the marginal utility of working and increases the opportunity cost of not working. But when the wage reaches an extremely high amount, the laborer may experience the law of diminishing marginal utility in relation to his salary. The large amount of money he is making will make further money of little value to him. Thus, he will work less and less as the wage increases, choosing instead to spend his time in leisure. The backwards bending supply curve has also been observed in non labor markets, including the market for oil.

Another example of a nontraditional supply curve is the supply curve for utility production companies. Because a large portion of their total costs are in the form of fixed costs, the marginal cost supply curve for these firms is often depicted as a constant.

Another postulated variant of a supply curve is that for child labor. Supply will increase as wages increase, but at a certain point a child's parents will pull the child from the child labor force due to cultural pressures and a desire to concentrate on education. The supply will not increase as the wage increases, up to a point where the wage is high enough to offset these concerns. For a normal demand curve, this can result in two stable equilibrium points a high wage and a low wage equilibrium point.

**Demand schedule:** The demand schedule, depicted graphically as the demand curve, represents the amount of a good that buyers are willing and able to purchase at various prices, assuming all other non price factors remain the same. The demand curve is almost always represented as downwards sloping, meaning that as price decreases, consumers will buy more of the good.

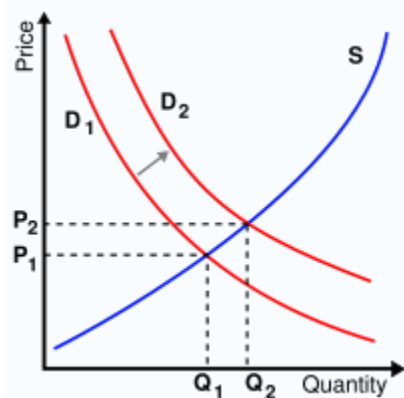
Just as the supply curves reflect marginal cost curves, demand curves are described as marginal utility curves. The main determinants of individual demand are the price of the good, level of income, personal tastes, the price of substitute goods, and the price of complementary goods. The shape of the aggregate demand curve can be convex or concave, possibly depending on income distribution.

As described above, the demand curve is generally downward sloping. There may be rare examples of goods that have upward sloping demand curves. Two different hypothetical types of goods with upward sloping demand curves are a Giffen good, a type of inferior, but staple, good and a Veblen good, a good made more fashionable by a higher price.

Changes in market equilibrium:

Practical uses of supply and demand analysis often center on the different variables that change equilibrium price and quantity, represented as shifts in the respective curves. Comparative statics of such a shift traces the effects from the initial equilibrium to the new equilibrium

### Demand curve shifts



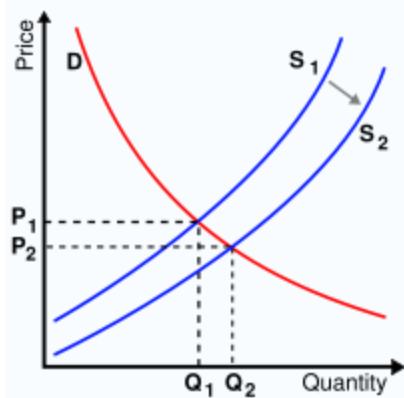
An out or right shift in demand changes the equilibrium price and quantity.

People increasing the quantity demanded at a given price are being referred to as an increase in demand. Increased demand can be represented on the graph as the curve being shifted right, because at each price point, a greater quantity is demanded, as from the initial curve  $D_1$  to the new curve  $D_2$ . An example of this would be more people suddenly wanting more coffee. In the diagram, this raises the equilibrium price from  $P_1$  to the higher  $P_2$ . This raises the equilibrium quantity from  $Q_1$  to the higher  $Q_2$ . In standard usage, a movement along a given demand curve can be described as a "change in the

quantity demanded to distinguish it from a change in demand, that is, a shift of the curve. In the example above, there has been an increase in demand which has caused an increase in equilibrium quantity. The increase in demand could also come from changing tastes, incomes, product information, fashions, and so forth.

Conversely, if the demand decreases, the opposite happens: a leftward shift of the curve. If the demand starts at  $D_2$  and then decreases to  $D_1$ , the price will decrease and the quantity will decrease. Notice that this is purely an effect of demand changing. The quantity supplied at each price is the same as before the demand shift (at both  $Q_1$  and  $Q_2$ ). The reason that the equilibrium quantity and price are different is the demand is different. At each point a greater amount is demanded when there is a shift from  $D_1$  to  $D_2$ .

### Supply curve shifts



An out or right shift in supply changes the equilibrium price and quantity

When the supplier's costs change for a given output, the supply curve shifts in the same direction. For example, assume that someone invents a better way of growing wheat so that the cost of wheat that can be grown for a given quantity will decrease. Otherwise stated, producers will be willing to supply more wheat at every price and this shifts the supply curve  $S_1$  to the right, to  $S_2$ —an increase in supply. This increase in supply causes the equilibrium price to decrease from  $P_1$  to  $P_2$ . The equilibrium quantity increases from  $Q_1$  to  $Q_2$  as the quantity demanded increases at the new lower prices. Notice that in the case of a supply curve shift, the price and the quantity move in opposite directions.

Conversely, if the quantity supplied decreases at a given price, the opposite happens. If the supply curve starts at  $S_2$  and then shifts leftward to  $S_1$ , the equilibrium price will increase and the quantity will decrease. This is purely an effect of supply changing. The quantity demanded at each price is the same as before the supply shift (at both  $Q_1$  and  $Q_2$ ). The reason that the equilibrium quantity and price are different is the supply changed.

There are only 4 possible movements to a demand/supply curve diagram. The demand curve can move to the left and right, and the supply curve can also move only to the left or right. If they do not move at all then they will stay in the middle where they already are.

**Market clearance:**

A market clears at the point where the quantity demanded is equal to the quantity supplied. Markets which do not clear will react in some way, either by a change in price, or in the amount produced, or in the amount demanded. Graphically the situation can be represented by two curves: one showing the price quantity combinations buyers will pay for, or the demand curve, and one showing the combinations sellers will sell for, or the supply curve. The market clears where the two curves intersect. In a general equilibrium model, all markets in all goods clear simultaneously and the price can be described entirely in terms of tradeoffs with other goods. For a century most economists believed in Say's Law, which states that markets, as a whole, would always clear and thus be in balance.

The market clearing price contains no maximization basis. As a result, any disequilibrium excess demand or excess supply is just a matter of graphical exercises. Some economists regarded that a demand curve could be represented by a diminishing marginal use value curve, the schedule of a consumer's maximum willing to pay with different quantity endowments. By this framework, people will buy when the market price is low enough, and they will sell when the price is high enough. In market clearing condition, the market price implies that the marginal use value of all participants is equalized. In other words, mutual gain of exchange is exhausted. Here comes the basis of maximization for the concept of market equilibrium.

**Elasticity:**

An important concept in understanding supply and demand theory is elasticity. In this context, it refers to how supply and demand changes in response to various stimuli. One way of defining elasticity is the percentage change in one variable divided by the percentage change in another variable (known as arc elasticity because it calculates the elasticity over a range of values, in contrast with point elasticity that uses differential calculus to determine the elasticity at a specific point). Thus it is a measure of relative changes.

Often, it is useful to know how the quantity demanded or supplied will change when the price changes. This is known as the price elasticity of demand and the price elasticity of supply. If a monopolist decides to increase the price of their product, how will this affect their sales revenue? Will the increased unit price offset the likely decrease in sales volume? If a government imposes a tax on a good, thereby increasing the effective price, how will this affect the quantity demanded?

If you do not wish to calculate elasticity, a simpler technique is to look at the slope of the curve. Unfortunately, this has units of measurement of quantity over monetary unit, which is not a convenient measure to use for most purposes. So, for example, if you

wanted to compare the effect of a price change of gasoline in Europe versus the United States, there is a complicated conversion between gallons per dollar and liters per euro. This is one of the reasons why economists often use relative changes in percentages, or elasticity. Another reason is that elasticity is more than just the slope of the function, it is the slope of a function in a coordinate space, that is, a line with a constant slope will have different elasticity at various points.

Let's do an example calculation. We have said that one way of calculating elasticity is the percentage change in quantity over the percentage change in price. So, if the price moves from \$1.00 to \$1.05, and the quantity supplied goes from 100 pens to 102 pens, the slope is  $2/0.05$  or 40 pens per dollar. Since the elasticity depends on the percentages, the quantity of pens increased by 2%, and the price increased by 5%, so the price elasticity of supply is  $2/5$  or 0.4.

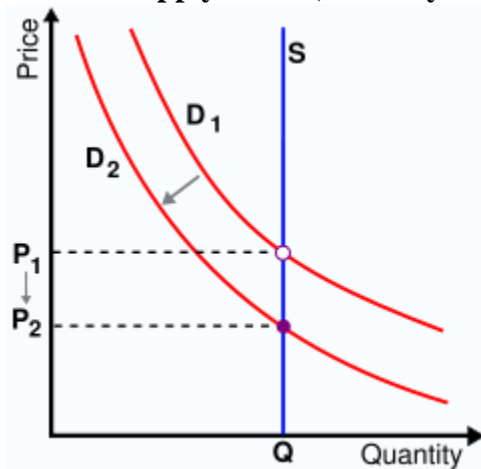
Since the changes are in percentages, changing the unit of measurement or the currency will not affect the elasticity. If the quantity demanded or supplied changes a lot when the price changes a little, it is said to be elastic. If the quantity changes little when the price changes a lot, it is said to be inelastic. An example of perfectly inelastic supply, or zero elasticity, is represented as a vertical supply curve. (See below)

Elasticity in relation to variables other than price can also be considered. One of the most common to consider is income. How would the demand for a good change if income increased or decreased? This is known as the income elasticity of demand. E.g. How much would the demand for a luxury car increase if average income increased by 10%. If it is positive, this increase in demand would be represented on a graph by a positive shift in the demand curve, because at all price levels, a greater quantity of luxury cars would be demanded.

Another elasticity that is sometimes considered is the cross elasticity of demand, which measures the responsiveness of the quantity demanded of a good to a change in the price of another good. This is often considered when looking at the relative changes in demand when studying complement and substitute goods. Complement goods are goods that are typically utilized together, where if one is consumed, usually the other is also. Substitute goods are those where one can be substituted for the other, and if the price of one good rises, one may purchase less of it and instead purchase its substitute.

Cross elasticity of demand is measured as the percentage change in demand for the first good that occurs in response to a percentage change in price of the second good. For an example with a complement good, if, in response to a 10% increase in the price of fuel, the quantity of new cars demanded decreased by 20%, the cross elasticity of demand would be  $-20\%/10\%$  or,  $-2$ .

### Vertical supply curve (Perfectly Inelastic Supply)



When demand  $D_1$  is in effect, the price will be  $P_1$ . When  $D_2$  is occurring, the price will be  $P_2$ . Notice that at both values the quantity is  $Q$ . Since the supply is fixed, any shifts in demand will only affect price.

It is sometimes the case that a supply curve is vertical: that is the quantity supplied is fixed, no matter what the market price. For example, the amount of land in the world can be considered fixed. In this case, no matter how much someone would be willing to pay for a piece of land, the extra cannot be created. Also, even if no one wanted all the land, it still would exist. If land is considered in this way, then it warrants a vertical supply curve, giving it zero elasticity (i.e., no matter how large the change in price, the quantity supplied will not change). On the other hand, the supply of useful land can be increased in response to demand by irrigation. And land that otherwise would be below sea level can be kept dry by a system of dikes, which might also be regarded as a response to demand. So even in this case, the vertical line is a bit of a simplification.

Supply-side economics argues that the aggregate supply function, the total supply function of the entire economy of a country is relatively vertical. Thus, supply siders argue against government stimulation of demand, which would only lead to inflation with a vertical supply curve.

#### **Other markets:**

The model of supply and demand also applies to various specialty markets. The model applies to wages, which are determined by the market for labor. In this instance, the typical roles of supplier and consumer are reversed. The suppliers are individuals, who attempt to sell their labor for the highest price. Conversely, the consumers of labors are businesses, which attempt to buy the type of labor they need at the lowest price. The equilibrium price for a certain type of labor is the wage.

The model is also held to apply to interest rates, which are determined by the money market. In the short term, the money supply is a vertical supply curve, which the central bank of a country can control through monetary policy. The demand for money intersects with the money supply to determine the interest rate.

**Other market forms:**

In a situation in which there are many buyers but a single monopoly supplier that can adjust the supply or price of a good at will, the monopolist will adjust the price so that his profit is maximized given the amount that is demanded at that price. This price will be higher than in a competitive market. A similar analysis using supply and demand can be applied when a good has a single buyer, a monopsony, but many sellers.

Where there are both few buyers and few sellers, the theory of supply and demand cannot be applied because both decisions of the buyers and sellers are interdependent changes in supply can affect demand and vice versa

The supply curve does not have to be linear. However, if the supply is from a profit maximizing firm, it can be proven that supply curves are not downward sloping (i.e., if the price increases, the quantity supplied will not decrease). Supply curves from profit maximizing firms can be vertical, horizontal or upward sloping. While it is possible for industry supply curves to be downward sloping, supply curves for individual firms are never downward sloping.

Standard microeconomic assumptions cannot be used to prove that the demand curve is downward sloping. However, despite years of searching, no generally agreed upon example of a good that has an upward sloping demand curve has been found (also known as a giffen good). Non economists sometimes think that certain goods would have such a curve. For example, some people will buy a luxury car because it is expensive. In this case the good demanded is actually prestige, and not a car, so when the price of the luxury car decreases, it is actually changing the amount of prestige so the demand is not decreasing since it is a different good. Even with downward sloping demand curves, it is possible that an increase in income may lead to a decrease in demand for a particular good, probably due to the existence of more attractive alternatives which become affordable, a good with this property is known as an inferior good.

**Empirical estimation:** The demand and supply relations in a market can be statistically estimated from price and quantity data using the simultaneous system estimation (structural estimation) method in econometrics. An alternative to structural estimation is reduced form estimation. Parameter identification problem is a common issue in structural estimation. Typically, data on exogenous variables, that is, variables other than price and quantity, both of which are endogenous variables are needed to perform such estimation.

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