Principles of Macroeconomics: Lecture Notes

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Associated videos and other content available at
bit.ly/2yO4GUS

Introduction

The following notes summarize what I typically teach in a one-semester, college-level Principles of Macroeconomics course. I also recorded some video lectures a few years ago (available at bit.ly/2yO4GUS) that explain some of the more mathematical and graphical concepts. These notes are not a substitute for coming to class (I go into much more detail), but, combined with textbook readings and/or the videos, it is possible to use these to get a solid grasp of basic macroeconomics.

These notes follow my own structure to this course—other instructors will do things differently. I usually devote much of the class to real-life applications of these concepts, as well as to macroeconomic policy. In these notes, I spend more time on the role of capital in the production process, as well as its "price" (the interest rate); I emphasize the role of monetary policy more than fiscal policy; and as an international economist I also like to discuss exchange rates.

I try to match what real-world policymakers do and how actual people think, so I don't take an overly Classical or Keynesian approach. I do assume that policy plays a role in the macroeconomy, and that "sticky" prices and information asymmetries mean that the market does not adjust perfectly. At the same time, I don't do many of the Keynesian multipliers, and also try to explain schools of thought beyond the main two.

Much of my lecture material has come from a variety of sources over the years. Recently, I have assigned one of these books, which come closest to matching the material I present:

Gerald Stone, *CoreMacroeconomics*; this was eventually taken over by Eric Chiang and re-titled *Macroeconomics: Principles for a Changing World*.

O'Sullivan, Perez, and Sheffrin, *Microeconomics: Principles, Applications, and Tools*.

I generally do not assign a particular edition—just whatever is sufficiently recent and sufficiently inexpensive. I have also moved more toward free online resources, including the Macroeconomics text available through Openstax. For that reason, I don't align these concepts to specific chapters or pages in a specific book. Being able to use an index can save you a lot of money!

The 24 topics covered here are:

1. Overview of Economics and Macroeconomics
2. Thinking Like an Economist; Microeconomic Models
3. The Cost-Benefit Graph
4. Factors of Production and the Production Function
5. The Production Possibilities Frontier (PPF)
6. The Market Mechanism and Supply and Demand
7. Shifts in Supply and Demand
8. Market Failures (*Unit 1*)
9. Gross Domestic Product (GDP)
10. The Consumer Price Index and Inflation
11. GDP and Inflation: Numerical Example
12. Calculating Unemployment
13. Long-Run Growth and Short-Run Fluctuations
14. The Consumption Function and the Spending Multiplier
15. The Aggregate Expenditure (AE) Model
16. Deriving the Aggregate Demand (AD) Curve (*Unit 2*)
17. Schools of Thought and the Aggregate Supply (AS) Curve
18. Expansionary and Contractionary Policy
19. Taxation and Fiscal Policy
20. Money and Monetary Policy
21. The Money Market and Interest Rates
22. Understanding Exchange Rates
23. Exchange Rates: Numerical Example
24. Exchange-Rate Movements (*Unit 3*)

These go in the order I present the topics in class, although they might be able to be used individually.

Enjoy!

1. Overview of Economics and Macroeconomics

Sometimes students enroll in an Economics class with literally no idea what it is. Once they find out what more, though, they often realize that it can be used in all majors. This is true not just for business majors, but also for other social and natural sciences. Not only that, but since everybody makes economic decisions, knowing some economics might actually pay for itself. Concepts like interest rates and the economy's performance come up a lot when buying a house, for example.

Economics a *decision* science that can be defined in one phrase as *how to efficiently allocate scarce resources*. In other words, there is a best way to do things so that people are as well-off as possible. Doing the "wrong" thing means that someone does not get what they need. Much of this course involves finding the **optimal**, or best, quantity of some activity. Doing too much, or doing too little, makes people worse off. These decisions can be made by individuals, businesses, or governments. Some applications include:

- How many pizzas should I eat right now?
- How many people should a company hire?
- Should I upgrade my subscription to "Premium"?
- How should healthcare decisions be made to get people the best outcomes?

Workers are costly—if a firm hires too many, it will have to pay them even if there isn't any work to do. Or, if they hire too few, the work can't get done at all! Economics looks at how to calculate these costs and benefits, both to the firm and to the worker.

Economics principles courses are generally divided into two halves. **Microeconomics** deals with choices made by individuals, firms, or groups of firms (called *industries*). **Macroeconomics** generally deals with national-level concerns. Some concepts can be applied to smaller units (the state of Illinois, for example, can have its own unemployment rate), but usually countries are examined because they control their own currency. Illinois can't print money to address unemployment the way the Federal government can.

Principles of Macroeconomics courses generally start with basic Microeconomics—in fact, the first four weeks of a one-semester course in each might be identical—because these concepts are essential to all

decisions. A lot of professional economists think that all of macroeconomics is based on microeconomics, but that isn't always the case.

After the first section of the course, which covers everything up to Supply and Demand, the two courses look very different. Microeconomics goes into measuring welfare; calculating elasticity and costs; and evaluating industry structure. Macroeconomics covers **aggregate** economic activity, which is "added up" over an entire country. I structure my class to cover three sections:

* Macroeconomic measurements (GDP, inflation, and unemployment)
* Macroeconomic models (Aggregate Expenditure and AS-AD)
* Macroeconomic policy (Fiscal, Monetary, and International)

The measurements can be used to determine *how* a country is performing economically, while policy can use the models to improve those numbers.

The models, as well as math, also help students develop skills that can be used in more advanced courses, as well as in daily life. Economics at its highest levels uses calculus and other advanced math; here, we mostly use arithmetic and some algebra. I think it is good for everyone to develop these skills, but using math helps people make better economic decisions. Sometimes prices are "hidden"; for example, if a product is sold $4 each, or 8 for $35. Not doing division might lead you to waste money on the 8-pack. Knowing how interest rates work might save you thousands of dollars on a car or a house.

Students often worry about the math and graphs in an Econ class, but they are just tools to help make the concepts clearer and to show the implications of economic decisions. The level of math I use is not the most difficult for this type of class, but it is typical of a college-level Principles course. The next section describes the "Economic Way of Thinking," and introduces some basic microeconomics graphs.

2. Thinking Like an Economist; Microeconomic Models

Most people naturally think "economically," to some degree, even though there is plenty of room for people to base decisions on non-economic factors. In fact, a lot of advertising is based on how people *feel*—you don't see many ads that simply list the features of a product. That means two things: 1) A lot of decisions, especially those used in macroeconomic policy, don't follow "perfect" economic theory, and 2) Knowing some economics might help you make better decisions in real life.

Here are some important concepts related to how economists view these decisions:

1. People are assumed to be **rational**. That means that they use available information to make decisions that increase, not decrease, their well-being. Some economists go further and think people are *perfectly* rational, but I do not. People try their best, but we are not computers, so there are some imperfections. This will be important when we start thinking about how money has an effect on people's economic activity, even though mathematically it should not. Real life is full of examples of "irrational" behavior.
2. Economic decisions balance the ideas of **efficiency** and **equity**. Well-being can be increased for both producers (*productive efficiency*) and for consumers (*allocative efficiency*). But some decisions are made so that people get more of a fair share. Health care is a good example—without it, people will die. The United States has had numerous debates about this. Economics generally shows that equal distribution of scarce resources is less efficient (some will go to those who don't need it as much), but I always stress not to take this too far.
3. Economists view the effects decisions one at a time, using the concept of **ceteris paribus** (Latin for "other things equal"). For example, all else equal, you might like to take an earlier flight than you are thinking of booking. But when you see that it costs more, you keep the later one. It's the higher price (a second change) that drives your decision. You would have to compare two different times at the same price to see the effect of the time change.
4. Economic decisions are made by balancing *costs and benefits*. These are not necessarily monetary. Understanding **non-monetary costs** is crucial to making a good economic decision. Taking a bus cross-country is cheaper than flying, but takes far more time.

5. People respond to **incentives**. Changing the costs and benefits involved will change the outcome (these can get a worse result, too, sometimes known as "perverse incentives.")
6. The most important cost in Economics is **opportunity cost**, or the next best alternative given up when making a choice. Buying something means that the money can't be used on something else. But even if it's "free," there is always something else you could be doing instead.
7. Economic decisions are made at the **margin**, which means that the cost or benefit of doing "one more" of something is considered. Hiring one more worker costs money, so a business would need to see if the worker would produce enough to be worth hiring. The same can be said for reading one more page (or word!) of a .pdf—if it's not worth it, it would be better to stop and do something more useful instead.

I usually go over the following three models before getting to Supply and Demand. They help show all these concepts:

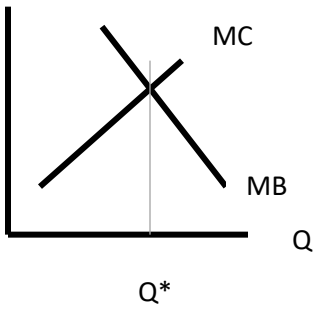
1. The **cost-benefit graph**, which shows how marginal costs rise, and marginal benefits fall, as the quantity of some good, service, or activity increases. This shows the core idea behind economic decision-making, and is the basis of the Supply and Demand model. It also helps show how graphs work.
2. The **production function**, which is sometimes covered only in a microeconomics course. This shows the role of labor (and capital!) in producing output, and helps show how the PPF is derived. It also shows diminishing marginal returns, which is the basis for the **marginal benefit** curve.
3. The **Production Possibilities Frontier** (PPF), which shows the trade-offs involved in economic choices, as well as limits to these choices. It also shows inefficient uses of resources. I also teach International Trade—this curve comes up a lot when explaining both the benefits of trade and the standard trade theories.

3. The Cost-Benefit Graph

This is just one example of an Economics graph. Before beginning, it might be useful to review how curves represent relationships between variables. Graphs are plotted on an x-y axis, with two variables. Usually, the dependent variable (the "effect") is on the vertical (y) axis, and the independent variable (the "cause") is on the horizontal (x) axis. But is important to note that these relationships don't always represent cause and effect. Variables might be related for other reasons, or the apparent relationship might be totally random.

A **positive relationship** is shown by an upward-sloping curve; increases in *x* might lead to increases in *y*. A **negative relationship** is shown by a downward-sloping curve; increases in *x* might lead to decreases in *y*. There are two types of **independent relationship**: One is a horizontal line, with one value of y regardless of x; the other is a vertical line with one value of *x* regardless of *y*.

In the cost-benefit graph, **marginal benefit** slopes downward with quantity (Q). This is because of scarcity. The more you do of one activity, the less capacity you have to enjoy it. **Marginal cost** slopes upward; the more you do, the more you have to give up. I show the math behind this via the production function and the marginal product of labor (MPN), but this makes intuitive sense to a lot of students.



If I binge-watch a show on Netflix, eventually I will be sick of it and not even remember what I am doing. Meanwhile, I have not showered in days. So there is definitely a good time to stop watching and do something else. Time is scarce, even if I don't have to pay for each additional episode that I watch (the marginal cost is $0, + time). The **optimal quantity** is shown as Q*. If I do *too little*, I give up enjoyment of the show, so watching more makes me happier. Marginal benefits are higher than marginal costs at this point. If I do *too much*, I never get to sleep. Here, marginal costs are higher than optimal benefits. Only where MB = MC is there no room to improve. This **equilibrium** point represents a key concept in Economics.

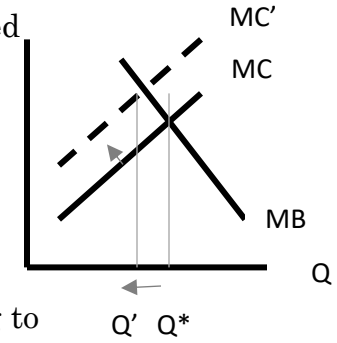
This graph, like others we will see, only can represent two variables at a time. To draw the influence of something else, you need to *shift one of the curves***.** This is basically ignoring *ceteris paribus* and

allowing all else not to be equal. Changes in costs or benefits will lead to changes in Q*.

The easiest way to think of how to do this correctly this is to think of *two curves* and *two directions*. Are *costs* affected, or are *benefits*? And are costs (or benefits) *increased* or *decreased*? This will help you shift the correct line the correct direction. For higher costs, you raise MC up (away from the origin, which is zero). For decreased benefits, you shift MB lower, toward zero.

Then, you look at the *new equilibrium point*. Does it represent an increase or a decrease? This will tell you the most important answer—what happens to Q? The graphs are just tools to help us see what really happens.

For example, suppose that cigarettes are taxed so that they cost more to smoke. Costs increase, so MC shifts up. (Note how I draw the new line, label the shifts with "hashmarks," and note the new Q*) The new equilibrium point is at a lower Q. As a result, you can say that *cigarette taxes lead to less smoking*. You might say, "I knew that already," but Economics gives you the tools to apply this thinking to new questions that you might want to know the answer to, that might be surprising.



4. Factors of Production and the Production Function

The **production function** represents a mathematical relationship between *inputs* and *output*: If you put more in, you should get more out. In a higher-level course, there might be specific numbers in this function, so that you can calculate a numerical answer. Here, we just discuss that such a relationship exists. For example, your grade in a class might be a "function of your exam score." If you do well, you get a better grade. But you could also have, "your final grade is your percentage score." Then you would know the specific grade for a 92%.

This production generally includes **factors of production**, which combine to produce output. These factors are generally **labor** (human work), **capital** (machinery and equipment), and **land** (natural resources). Note that here, "land" is more than the place the business is located—it could also be wood or oil, for example. Capital is physical equipment, not financial capital. This factor is particularly important in macroeconomics, as increases in capital are considered to be **investment**. Oftentimes, additional factors include **human capital** (education or training that make workers more productive), as well as **entrepreneurship** (the organizational skill and risk-taking that forms the business). The idea of **technology** is more basic than the term we commonly use; here, it is anything that helps make each input more productive.

Each factor is paid according to its contribution. Labor, land, and capital are paid **wages**, **rent**, and **interest,** respectively. (Some books have slightly different terms, though.) I also abbreviate the factors **L**, **T**, and **K** (this differs too). In theory, each factor gets paid exactly what it produces, which is known as its **marginal product**. If a worker produces 3 units of a product, and the product costs $4, they should get paid exactly $12. If they produce less, they get laid off. If they produce more, they can negotiate a higher wage, either elsewhere or by threatening to quit. Most of us probably get paid less than our marginal product, because these markets are not perfect.

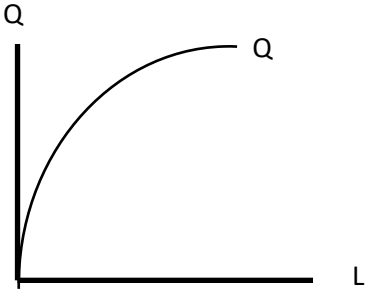
But it is important to note that the providers of all three factors should be paid. If you work in a factory, and you need a machine to do your job, you need to split the payment with the factory owner. In real life, this is not always equal. But sometimes workers feel like they should get paid 100% of the production.

A farm, for example, uses land (as well as water, which is also considered to be "land."). Centuries ago in Illinois, more labor was required per unit of land, because machinery was less developed. Now, giant machines have now replaced labor. And technology—whether it is pesticides or even accurate weather forecasting—have greatly increased the output of crops.

One important part of the production function is that doubling one of the inputs, for example, likely will not lead to double the output, due to diminishing returns. This is due to scarcity in the other inputs. Having 10 times the workers on a farm will not add to production without having 10 times as much capital and land. If there are workers without machines, they cannot help grow anything.

For that reason, the production function is *increasing at a decreasing rate*. The increases can be represented as a separate marginal product graph, which is downward-sloping. This is directly related to the marginal benefit—how much a farmer helps grow is the benefit they add to the farm. If you take the reciprocal of the marginal product, you can get a marginal cost, which is rising.

The associated exercise graphs the following information for Labor inputs and Quantity output. Marginal product of labor (MPL) is simply the change in Q as L increases; since $\Delta L = 1$, $MP = \Delta Q$. An additional exercise would be to pay each worker \$24 and calculate the "per-unit" marginal cost (\$12/ ΔQ). As *MP* falls, *MC* rises. This graph can show how the MC and MB curves are derived. Also, if *technology* improves, output per worker increases and the function shifts up.

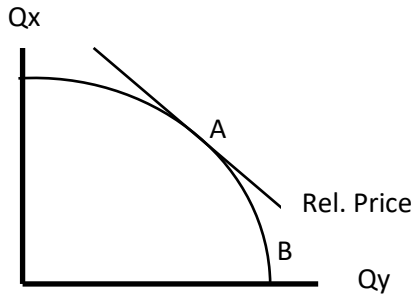


L	Q	MPL = MB	MC = \$24/MPL
0	0	-	-
1	12	12	2
2	20	8	3
3	24	4	6
4	27	3	8
5	29	2	12
6	30	1	24

5. The Production Possibilities Frontier (PPF)

The **PPF** shows the *limits* of production, divided between two activities, with a limited amount of resources. It is "bowed out," with its curve shape resulting for the same reason—diminishing returns—as the production function. In fact, I show how to draw the PPF starting with two production functions. Since making more of one thing means making less of the other, it shows the **tradeoffs** and opportunity costs involved in economic decision making.

The PPF also shows how costs rise and benefits fall. One way to do this is by drawing a *tangent line* at any point on the curve. Since its slope is *rise/run*, it shows *losses* in Qx divided by *gains* in Qy. This is the *relative price* of one product in terms of another. Moving toward Qy, for example (from A to B), makes the price steeper—you need to give up even more X for even less Y. In other words, the costs rise and the benefits fall.



This graph also shows **productive efficiency:** Any point on the PPF uses all resources efficiently. Any point might be preferred, as long as the producer is willing to pay the price. Inside the curve, not all resources are being used; this is **inefficient**. Points outside the curve are **unattainable**, since there are not enough resources.

Qx	Qy
0	30
12	29
20	27
24	24
27	20
29	12
30	0

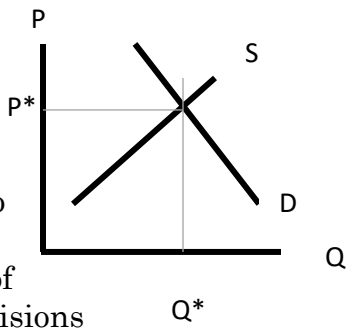
The PPF can be expanded by adding resources or through **economic growth**, which will be explained later. International trade theory shows how a country might specialize in one good, import the other, and as a result consume more than it can produce on its own. The associated example shows how a PPF can be drawn for two goods, sharing six workers, with identical production functions to the one drawn earlier.

6. The Market Mechanism and Supply and Demand

Economics is focused on the efficient allocation of scarce resources, and this is generally done through the **market mechanism.** Before beginning, though, it is important to note that markets are not the only way to do this. People might divide something equally, or have a lottery system where a chosen few get selected, or have a "first come, first serve" system. These are generally inefficient, as someone who needs the product most doesn't get it, while someone who doesn't need it does. On the production side, an inefficient firm might get a contract to make a product, so it costs more to produce than it needs to. Things can get even worse if resources are allocated through connections or discrimination, letting favored people to the front of the line. The market mechanism should allow resources to go to people who want or need them most, and to be produced by firms that make them best.

Governments play a role in allocating resources. On a national level, we call an economy where the government allocates all resources a **command economy**; the opposite extreme is known as a **market economy**. Most economies are a **mixed economy**, with some resources allocated by each. But the mix differs—health care, for example, is (mostly) privately run in the United States, and is nationally run in other countries. There is some government regulation even in a market economy, and even Communist countries like the Soviet Union had some private production and markets. I usually leave some room for the government to play a role, even in an economy such as the United States.

The market for a good or service is represented by the well-known **Supply and Demand** graph. It represents two groups, who meet in the market to exchange. Each has their own goals to maximize their well-being, and they act mostly separately, but they communicate through the **price** to tell each other what to do (in this case, the **quantity**—to make more or less).



Consumers maximize **utility**, or the usefulness of the product (or the happiness it gives them). Their decisions are represented by the Demand curve, which slopes downward due to the **Law of Demand**. I usually give three explanations for this:

1) Common sense—if something costs less, we might buy more.

2) The fact that marginal benefits are falling—the more we buy, the less utility we get, so we won't pay as much for it.
3) This represents a *ranking* of consumers from high- to low-benefit. If you allocate only Q* units, the people who want it most get it.

Producers maximize **profit**, represented as *Revenue* − *Cost*. Their decisions are represented by the Supply curve, which slopes upward due to the **Law of Supply**. My three explanations for this are similar:

1) Common sense—if something pays more, we might do it more.
2) The fact that marginal costs are rising—the more we do, the higher the opportunity cost, so we need to be paid more for it.
3) This represents a *ranking* of producers from low- to high-cost. If you produce only Q* units, the firms who use fewer resources get to make it.

Each curve represents a range of possibilities—I don't know how much I will buy until I see the price—but when buyers and sellers meet, there is one price and one quantity for both. The **equilibrium** point is where Supply and Demand cross—this is the most efficient point. This is similar to what the Cost-Benefit graph shows for quantity, but here there is P* as well as Q*. If the price is too high, there is too much produced and not enough bought, leading to a **surplus**.

Market forces should naturally restore equilibrium, though, as producers have to lower their price, which means more is bought. These forces are basically just producers increasing profit and consumers increasing their utility. Likewise, if the price is too low, there will be a **shortage**, which can be alleviated as consumers who can't find the product bid the price up, which tells the producers to make more.

Price ceilings are when the government sets a price below the market price P*, and the law keeps market forces from doing their job. (I always also emphasize that corporate policy, long-term strategy, or social norms also keep prices from rising or falling in many cases.) While these might benefit some consumers, they hurt other consumers (who can't buy the item) and producers (who make less profit and have to reduce quantity supplied).

Price floors are similar—except that the price is above P*. This helps some producers, who get more money; other producers (who have surpluses they cannot sell), as well as consumers, are hurt. In a principles of microeconomics class, welfare analysis would show this in more detail.

7. Shifts in Supply and Demand

The Supply and Demand curves represent producer and consumer decisions under one set of conditions. Just like with the Cost-Benefit graph, changing anything but *the price of the product itself* shifts one of the curves.

The best way to do this is to answer the following:

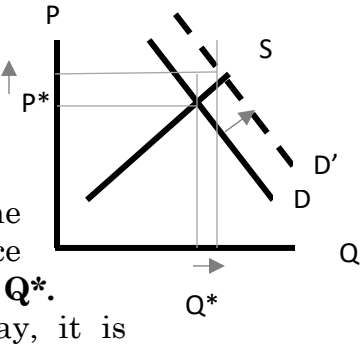
- Is the *price* changing, or *something else*?
- Are conditions changing for *producers*, or *consumers?*
- Is it *more* or *less*?

The first question tells you whether you move *along the curve* or need to *shift the curve*. The second tells you which one: Producers are represented by Supply, and Consumers are represented by Demand. More supply (or lower costs) shift the curve to the right and down; More demand shifts the curve to the right and up.

Once you move a curve, you don't necessarily have to shift the other. If the price increases after a demand shift, for example, this encourages increased production due to the Law of Supply and you move up the curve without shifting it.

Next, you note the *new equilibrium point* and compare the new P* and Q*. Have they increased or decreased? This is the point of this model—*you can predict changes in these variables.*

For example, if your neighborhood becomes more popular, **more consumers** want to live there. You shift **Demand right**, and note the new equilibrium point. The supply of housing does increase—higher prices might lead to more construction, or individuals renting out more units. People might tear down a building to build a high-rise because the higher price is now worth the cost. (We move along the Supply curve.) You will notice that the new equilibrium has a **higher P*** and a **higher Q*.**



While I encourage thinking it through this way, it is important to memorize the main causes of these shifts. **Supply increases** due to *technological improvements*, *lower input costs* (including taxes), and *more suppliers*. **Demand increases** due to increased income, changes in the price of related goods (lower prices for *complements* and higher prices for *substitutes*; *tastes and preferences*; and *more buyers.* Changes in the opposite direction cause decreases in Supply or Demand as well.

8. Market Failures

While the market works well in efficiently allocating resources, it is not perfect. **Market failures** occur when the price mechanism or market forces do not achieve the intended goal of maximum well-being. I usually focus on four of them:

1) **Monopoly** is a lack of competition (in this case, only one seller of a product). Without competition, a monopoly firm can lower the quantity, increase its price, and lead to lower overall welfare. Governments can regulate industries, by setting prices or approving mergers. This is an important topic in a principles of microeconomics course.

2) **Externalities** occur when the cost or benefit of an activity falls on a *third party*, who is neither the buyer or the seller of a good. Pollution is a classic example of a **negative externality**, because a factory does not pay the full cost of production. The neighbors pay as well. Education has **positive externalities**, benefitting even people who do not go to school. Usually, pollution can be taxed, and education can be subsidized—society takes care of these extra costs or benefits. I show this on the cost-benefit graph in microeconomics.

3) **Public goods** are hard to profit from. They are typically *non-rival*, meaning that one person's use does not deprive another person from using it. They are also *non-excludable*, which means that people who don't pay can still use it. Police and fire departments are two examples. Sometimes, this is considered to be a type of externality—my house is actually safer if my neighbor's house is too. These services are usually provided by governments, although volunteer fire departments do exist.

4) **Asymmetric Information** is probably most relevant to macroeconomics. If the two sides of an economic transaction lack the same knowledge, one side might hesitate, and the market falls apart. Banks, for example, need to know who will pay loans back, so they find out your credit history. If they couldn't, a problem known as *adverse selection* would arise, and they wouldn't lend anyone any money if they thought no one would pay. Banks also make sure you don't use loans for the non-intended purpose, which avoids *moral hazard*.

9. Gross Domestic Product (GDP)

GDP is the first—and possibly the most important—of the three **macroeconomic measurements.** It is a measure of a nation's production, income, and spending (at the same time). It is a **flow variable**, which means that it is measured over time—usually annually. **Stock variables** are independent of time; wealth is an example. For example, you could make $20 per hour (a flow) and have $200 in the bank (a stock).

GDP can be defined as "*the dollar value of all new, final goods and services produced within the borders of a country during a calendar year*." Each part of this is important: GDP is measured in dollars, so that all goods, of different sizes and quality levels, can be compared. Services, which cannot be counted, can also be included. GDP is an **aggregate** variable, adding up these values. GDP counts *final goods*, not *intermediate goods*, and does not count anything that is re-sold. For example, if I buy a used car, it does not count a second time, or else it would look like there were two cars ("*double-counting*"). The new car also includes all the parts that went into it; the sales price includes four tires, so when the car company bought them as intermediate goods, they are not counted there. Spending money on the car also reflects the production of the car as well as the income of the people and machines that made it. GDP counts *domestic* production, so Toyota plants in the U.S. count toward U.S., not Japanese, GDP. Some payments, though, count toward Japanese Gross National Product (GNP). Sometimes people confuse the terms; they are similar in a lot of ways, but different in this case.

We assume that "more is better," so GDP increases are a goal in modern economies. But this is often criticized. GDP does not measure quality of life, as well as unpaid work, leisure, or activity that is hidden from the government. It also counts spending on "bad things," such as rebuilding after a hurricane.

GDP measured in current dollars is known as **nominal GDP**, but this does not consider inflation. (**Real values** are nominal values, adjusting for prices or inflation.) Usually I cover prices and **real GDP** simultaneously. This can be used to compare trends over time; since prices were lower in the past, GDP would appear to be very low unless you take this into account.

Besides measuring a country's annual real GDP in dollars, its **growth rate** (percentage change) is also important. This is done by calculating $\frac{GDP_2 - GDP_1}{GDP_1} \times 100\%$. This type of equation ($\frac{X_2 - X_1}{X_1} \times 100\%$) is used a lot in macroeconomics. Typically, a U.S. growth rate of 2% to 3% is considered to be a good target.

Additional variations of the GDP measure include real **GDP per capita** and its growth rate. This can be used as a measure of a standard of living. China, for example, has a very large GDP, but divided by its large population, its GDP per capita is not as large as the United States'.

Every country has its own target values for GDP; since GDP can decline, Economic policies can be used to improve this statistic.

Of the many available economic data sources available online, one of the easiest to use is the St. Louis Fed's FRED database (https://fred.stlouisfed.org/). You can plot all these variations, as well as thousands of other variables, for the U.S. and for many other countries.

10. The Consumer Price Index and Inflation

Inflation is an overall increase in prices, measured as the percentage change in a price index. Inflation is often given the Greek letter π (pi), which is a calculated number and NOT 3.1416. When prices fall, this is known as **deflation**, while **disinflation** refers to when inflation rates fall. Inflation is usually measured at the national level (but the choice of items to include in an "aggregate" price index can vary); the United States or Europe have a target of about 2% annual inflation. A **hyperinflation** is an exceptionally large increase in prices, sometimes measured as 50% per month or 1000% per year. This can destroy people's savings, as well as their quality of life.

While inflation is typically not as extreme in the U.S., high inflation is considered a problem because it erodes **real values**. If someone earns a fixed wage, but prices rise, their *real wage* (measured as w/P) will decline. The same thing can happen to someone's life savings; a fixed nominal amount can buy less if prices increase.

Even if you earn interest on your savings, they might still lose value if the inflation rate is higher than the nominal interest rate. The formula for the **real interest rate** is $nominal\ r - \pi$. If your bank pays 2%, but inflation is 1%, you really only earn 1%. And if inflation is 4%, you *lose* 2%.

One major measure of overall prices is the **Consumer Price Index**, which measures the price of a *basket* of goods for a typical family every year. The components of the basket are *weighted* by how much people typically spend; Housing makes up the largest component, and items like food, medical expenses, and transportation are also important. The **Bureau of Labor Statistics** collects data on this measure, which are available at *bls.gov*. They also have data using other baskets, such as the prices of education expenses alone.

CPI is converted from dollars into an *index* that has no units (it is not in dollars, percent, or anything!). It is further converted so that it equals 100 in a chosen **base year**. If prices increase, the CPI increases as well.

Inflation is the percentage change in CPI: $\pi = \frac{CPI_2 - CPI_1}{CPI_1} \times 100\%$.

11. GDP and Inflation: Numerical Example

This example shows how to calculate GDP, CPI, and inflation using the simple idea of growing fruit and selling fruit baskets. GDP can be calculated for the $n = 4$ fruit as $\sum_{i=1}^{n} P_i Q_i$. The idea is to see if there is more fruit in year 2 (real GDP growth), but you can't simply count the fruit because one apple is not the same as one watermelon. The prices should capture this difference. We can calculate **nominal GDP** in both years, as well as its **growth rate**. Usually, **real GDP** is preferred, though.

For real GDP, prices need to be removed somehow, since GDP is calculated using this changing measurement. There are two ways of calculating the price level. One is to hold prices constant, using Year 1 prices for both. Then only quantity changes are captured. I prefer to divide, using the formula $Real\ GDP = \frac{Nominal\ GDP}{CPI} \times 100$, since that is a useful method when using real data in Excel or other software. For CPI, we can price the fruit basket each year.

$$P_t{}^{basket} = \sum_{i=1}^{n} \alpha_i P_i$$

α is the weight assigned to each good (here, the quantity in the basket). Then we convert to 100 as follows:

$$CPI_t = \frac{P_t{}^{basket}}{P_{base}{}^{basket}} \times 100$$

	Year 1		Year 2			
	P	Q	P	Q	Basket	
Apples	\$0.75	100	\$1.00	110	*Apples*	2
Pears	\$1	80	\$2	75	*Pears*	2
Oranges	\$1.50	200	\$1.50	220	*Oranges*	4
Watermelons	\$5	50	\$4	55	*Watermelons*	1

Nominal GDP is \$705.00 in Year 1 and \$810.00 in Year 2, increasing by 14.89%. Most of this is inflation, though. The basket price goes from \$14.50 to \$16.00; the resulting CPIs are 100 and 110.34 (π = 10.34%). Real GDP goes from \$705.00 to \$734.06, or a 4.12% growth rate.

12. Calculating Unemployment

The **unemployment rate** is the percentage of the **labor force** that is not working, yet actively seeking employment. Not all people in a country (or a city or state, or a subgroup of people, which can also have their own unemployment rates) is in the labor force. Children, retirees, members of the military, and others—as well as those who choose not to work—are not. Typically in the United States about 50 to 70% of people make up this group. I usually calculate this in class as anyone who works at all, full-time or part-time (one hour per week is the threshold), plus those who are actively seeking work ("not working, but looking").

Unemployment is problematic for a number of reasons. If there is less labor in the production function, output and GDP go down. But workers are people, so this is worse than unused capital, for example. Unemployment can have a devastating impact on families and communities.

The commonly used measure of unemployment is often criticized because it understates **underemployment**—either working fewer hours or using fewer skills—than people would like. Unemployment rates can go down if people leave the labor force, even if they do so because they stop looking for a job. An increase in the number of **discouraged workers** might not be captured by this measure. The BLS has a number of alternative measures, which capture more of these impacts.

There are typically four types of unemployment. Here, I rank them in order of how much government policy can try to help: **Seasonal unemployment** is due to the fact that economic activity often increases in summer (and around holidays). Unemployment statistics are often *seasonally adjusted* to remove these patterns. Some textbooks ignore this one entirely. **Frictional unemployment** occurs because there are always movement and gaps between jobs. **Structural unemployment** results from a mismatch between available workers and available jobs; sometimes, governments help re-train workers. **Cyclical unemployment** is tied to GDP—if it increases, unemployment goes down, and vice-versa. The policies described later are designed to reduce this type of unemployment.

The **natural rate** of unemployment is the sum of frictional and structural unemployment—it is the most difficult to address using policy. In the United States, a typical target unemployment rate has

typically been about 5%. It is not 0%—if it were, it would be so difficult to find workers that wages, and inflation, would rise.

This numerical example shows how to use the formula:

$$u = \frac{NWL}{FT+PT+NWL} x\ 100\%$$

Note that only "not working, but looking" are in the numerator, and the denominator has only three groups.

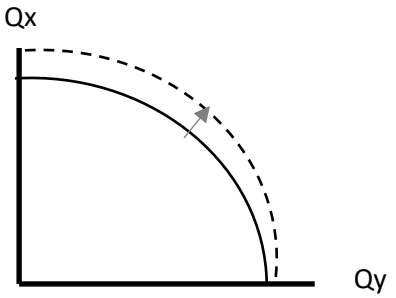
The three columns make changes to the first. In column 2, 20 people find full-time jobs, so unemployment goes down. But in column 3, 100 full-time workers get their hours cut, and the unemployment rate stays the same. In column 4, 25 people give up looking for work, and the unemployment rate goes down. The situation is worse, but the number is better, so the measurement does not capture its intended effect.

	(1)	(2)	(3)	(4)
Type	**# Workers**	**# Workers**	**# Workers**	**# Workers**
FT	400	420	300	400
PT	350	350	450	350
Not working, but looking	50	30	50	25
Not working, NOT looking	150	150	150	150
Discouraged Workers	125	125	125	150
Students	75	75	75	75
Military	25	25	25	25
0-15yrs	300	300	300	300
Retirees	175	175	175	175
All people	1650	1650	1650	1650
Labor Force	800	800	800	775
Employed	750	770	750	750
Unemployed	50	30	50	25
Participation Rate	59.26%	59.26%	59.26%	57.41%
Unemployment rate	**6.25%**	**3.75%**	**6.25%**	**3.23%**

13. Long-Run Growth and Short-Run Fluctuations

In the United States and many other countries, real GDP has tended to rise over time. This growth is not constant, however; there are also declines from time to time. These two effects—the long-run trend and the short-run cycle—each represent different economic issues. They also require different policies.

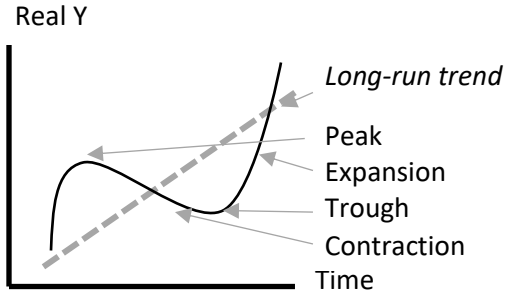
In economics, the **long run** means that all variables have sufficient time to adjust, while in the **short run** they do not. Microeconomics courses spend a lot of time on short-run and long-run costs, for example. In macroeconomics, the main variable is *prices*. Increasing the money supply might temporarily boost GDP, for example, but eventually increasing prices cancel this out, and there is no real effect.



Long-run growth strategy involves increasing productive capacity: Improving technology, increasing **human capital**, and building infrastructure are often employed. This can be drawn as an expansion of the PPF (as well as a shift up in the production function for a single good).

Short-run growth policy involves managing the **business cycle**. This can be graphed as real GDP over time. The four phases of the business cycle are the **peak**, the **trough**, the **expansion**, and the **contraction** (or recession). One cycle runs from peak to peak. There is no set length or depth to one cycle—each I different. There are different policies needed for each phase:

In a trough, **expansionary policy** is needed to boost employment, but at a peak, **contractionary policy** can reduce inflation brought on by excessive demand for goods. Most of the course after this point deals with this short-run policy.



14. The Consumption Function and the Spending Multiplier

GDP consists of four components, depicted in the equation:

$$Y = C + I + G + (X - M)$$

The largest component is **Consumption**, or spending by households. **Investment** is business purchases of capital (equipment or construction), which is important since the interest rate is the price of capital. **Government** spending includes a variety of purchases, but not things like Social Security, which fund consumption. **Net Exports** is **Exports** minus **Imports**; it can be negative if imports are larger.

One important relationship is the **consumption function**, which states that consumption is depends on income:

$$C = a + MPC \times Y$$

This is in slope-intercept form. The intercept, a, is **autonomous consumption**, which takes place even if income is zero. As income increases, consumption rises by a fraction of income (the rest is saved). If a person earns $100 and spends $50, they save the other $50. The fraction of additional consumption to additional income ($\Delta C/\Delta Y$) is called the **marginal propensity to consume**. This can take a value between zero (all saving) and one (no saving). This is also the slope of the consumption function.

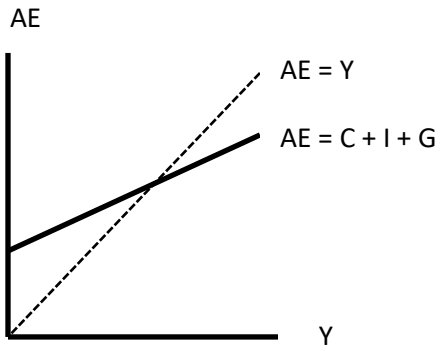
If C depends on Y, and Y depends on C, these reinforce each other so that spending increases has an outsize effect. This is known as the **multiplier effect.** One way to show this is through multiple "rounds" of spending (my spending becomes your income, which you spend, etc.), that only end because of the fraction that is not spent. With MPC = 0.5, if spending increases by $100, the next round is $50, followed by $25, $12.50, $6.25, etc. By the time it reaches zero, the sum of all rounds is $200. Total spending has doubled.

This can also be shown algebraically. Combining the two equations above (and assuming X = M), $Y = a + MPC \times Y + I + G$. We can move the Y's to the left-hand side, so that:
$Y(1 - MPC) = a + I + G$. If we divide, we get the formula for the multiplier: $Y = \frac{1}{1-MPC}(a + I + G)$. With MPC = 0.5, $1/(1 - MPC) = 2$. If MPC = 0.9, the multiplier is 10.

15. The Aggregate Expenditure (AE) Model

This model shows how increases in spending lead to disproportionately large increases in output, due to the multiplier effect. It is a graphical depiction of the consumption function and GDP equation.

The main "rule" of this model is that *income must equal spending* ($AE = Y$) in equilibrium. If $AE < Y$, the country is spending too much and inventories, which are a form of **saving**, build up. If $AE > Y$, then inventories are drawn down, which is known as **dissaving**. Each can be bad for employment and inflation.



This model graphs all equilibrium points as a 45-degree line, from AE = 0 and Y = 0 on up. The second line is actual aggregate expenditure, with an intercept of $a + I + G$ and a slope of *MPC*. Because MPC < 1, the *AE* line is flatter than $AE = Y$. Actual spending matches equilibrium spending only at one point—where the lines cross. (This graph is sometimes called the "Keynesian Cross," since it comes from Keynesian economics, but I always point out that it can apply to a pro-business policy as well). An increase in spending (in any GDP component) is a parallel shift in the AE line upward, with the new crossing point further to the right than the size of the upward movement, due to the multiplier effect.

An example where C = \$200 + 0.8Y, G = \$50, and I = \$50 can be shown to have a multiplier of $1/(1 - 0.8) = 5$. Solving first for only C and then adding ($I + G$ = \$100), equilibrium GDP begins at \$1000 and moves to \$1500 (an additional \$500) after a \$100 increase. In tabular form, we can fill in certain values, as well as Savings (S):

Y	C	S	I	G	(C + I + G)
0	200	-200	50	50	300
500	600	-100	50	50	700
1000	1000	0	50	50	1100
1500	1400	100	50	50	1500
2000	1800	200	50	50	1900
2500	2200	300	50	50	2300

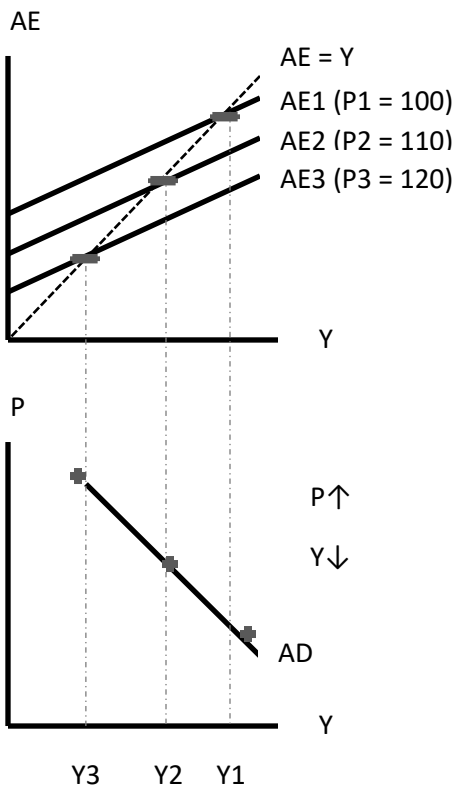
For C only, Y = AE at \$1000, and with I and G added, Y* is \$1500.

16. Deriving the Aggregate Demand (AD) Curve

The main model in principles of macroeconomics is the Aggregate Supply-Aggregate Demand (AS-AD) model. Like the AE model, it has output on its horizontal axis. But it has the second main macroeconomic variable—the price level—on its vertical axis. Since unemployment is negatively related to output, this model can include *all three main measures* at once. Shifts in the curves, driven by policy and other events, show how the economy changes.

The AD curve can be derived from the AE model by intruding *price changes* to shift the AE curve and get a new Y*. Increases in P mean less real spending, so AE shifts down and Y* decreases. The opposite is true if prices decrease. The equilibrium combinations of P and Y can be "mapped" to a new graph. (This mapping comes up a lot in higher-level courses. Changes in interest rates can derive the IS curve in Intermediate Macroeconomics or the DD curve in international finance.

Increases in spending (Consumption, Investment, Government, and even Net exports) simply mean you could re-draw the whole curve again, at higher GDPs for all points. This would then be an increase in AD, or a shift to the right. Likewise, a decrease in spending would shift AD to the left.



17. Schools of Thought and the Aggregate Supply (AS) Curve

While principles of macroeconomics courses primarily focus on two competing schools of thought, it is important to note that they share a lot of similarities. In class, I usually talk a lot more about some economic ideologies that lie outside the scope of the course. On the left of the political spectrum, for example, lies *Marxism*, which puts a heavy emphasis on labor over capital and calls for worker control of the means of production. While we don't go into much detail, one must keep in mind what the material we do cover is *not*. In other words, wanting to put a stop sign at a busy intersection does not make someone a Communist.

On the more libertarian end of the spectrum lies *Austrian* economics, which had proponents such as F.A. Hayek. It has some interesting ideas about the role of the price mechanism in organizing the economy, but leaves little role for macroeconomics since it leaves interest rates and money creation to the private sector. I mention two other schools, "Supply-Side" and Monetarism, under Fiscal and Monetary Policy, respectively.

The two main schools of thought are Classical and Keynesian economics. Classical economics can be traced back to Adam Smith's 1776 book *The Wealth of Nations*, which was revolutionary in its emphasis on specialization and trade as superior to a more mercantilist policy. John Maynard Keynes is credited with introducing macroeconomics; his 1936 book *The General Theory of Employment, Interest, and Money* outlined policies to escape the Great Depression.

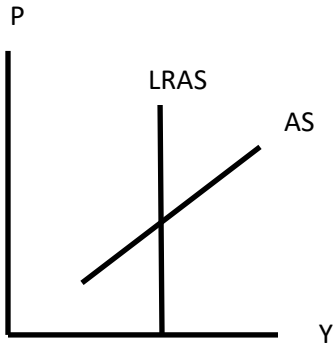
After the economic shocks of the 1970s, Classical economics regained its dominance. Neo- (or new) classical economics is prevalent in academia, while most American politicians adhere to free-market principles. But many Keynesian ideas persists—particularly the role of spending in boosting output, as well as the multiplier effect. This is applied a lot in urban planning; economists often model the economic benefits of building a stadium, for example.

The key difference between the two is that Keynesian economics leaves more room for *sticky prices* and *market imperfections*. Under Classical theory, prices adjust quickly, so there is no need for government intervention. In the long-run, though, both schools of thought are very similar. Keynesian economics simply has more of a short-run adjustment period.

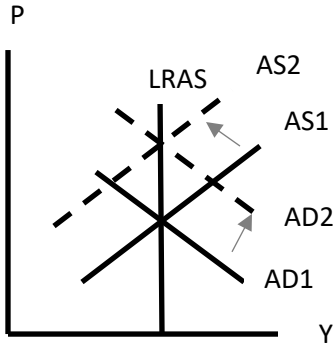
This is shown in the **Aggregate Supply** curve, which represents equilibrium in the labor market. Like the AD curve, it has the **price level** on the vertical axis and **output** on the horizontal axis. I usually focus on the Keynesian AS curve (otherwise known as the short-run AS or SRAS, curve) for two reasons. First, there is plenty of evidence for sticky prices and market imperfections in real life, and second, policymakers around the world act using similar models. This curve *slopes up and to the right*.

The Classical AS curve is the same as the Keynesian long-run AS (LRAS) curve. Both are vertical. They reach the same point eventually, but Keynesian economics takes longer to get there. My opinion is that in Classical economics, the "long run" is *now*.

Sometimes a textbook puts both together on a curved AS curve, with Keynesian operating at low GDP and classical at high GDP. This idea is based on *capacity utilization*—if there are unemployed workers, the government can more easily put them back to work without raising prices.



The AS curve can be derived from another graph (such as labor supply-labor demand), but I use a simpler example: Assume that labor depends on the **real wage**; the lower this wage, the more workers are hired, and the more output increases. Wages are "sticky" under Keynesian economics and flexible under Classical economics. If prices rise and wages stay the same, the real wage (w/P) falls, so demand for workers increases and equilibrium GDP rises. But if wages are flexible, both rise and it cancels out. Equilibrium output is the same.



The AS curve shifts to the right (and down) for reasons that make it *cheaper to produce more*. Key reasons include technological improvements, lower input costs (including labor and oil), and lower tax rates. The opposite moves AS to the left (and up).

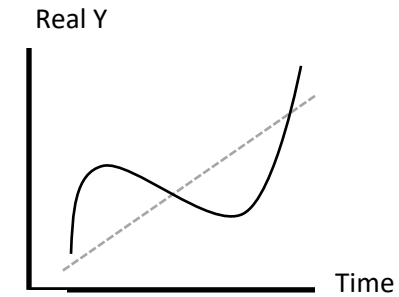
This shows how the Keynesian LRAS curve represents the Classical AS curve after an adjustment period. A spending increase shifts AD to the right, so prices rise. This increase in input costs causes AS to shift left. Connecting the original AS-AD equilibrium with the new, final equilibrium gives a vertical line. In class I usually focus on the first shift, however.

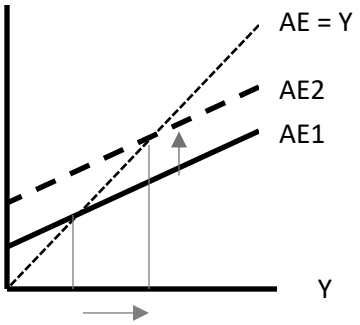
18. Expansionary and Contractionary Policy

Given the three macroeconomic measurements (GDP, inflation, and unemployment) and their target values, it is possible for a government to use **macroeconomic policy** to try to improve these variables. In the United States, this is primarily done by the Federal government, since only this entity can run large budget deficits as well as print its own money. There is also more movement across state and city borders; if one area raises taxes too much, for example, people and businesses might move across the border.

It is also important to note that Classical and other more libertarian schools of thought might advocate doing *nothing* (or very little) to manage the economy. Instead, economic forces might do the job—if unemployment is high, for example, wages should drop and hiring would increase, but minimum wage laws (a price floor on labor) might thwart this process. Or, an increase in the money supply might lead to increased spending and output, but if prices rise quickly, the real money supply (Ms/P) will be unchanged and there will be no effect other than inflation. I usually take an approach that gives most weight to monetary policy, and I also assume that it is indeed effective.

All types of policy—**fiscal**, **monetary**, and **exchange-rate**, will move the curves the same way. If real GDP is below trend (where it "should" be) on the business cycle, **expansionary policy** can be used to increase GDP. It will also increase inflation, but that is the "side effect" that must be balanced when policymakers make decisions. **Contractionary policy** can be implemented if inflation is high; it lowers real GDP, which is above its target value. This is not good, but is another tradeoff.

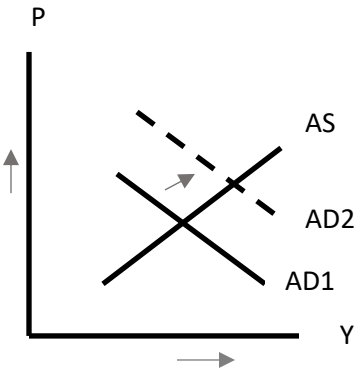




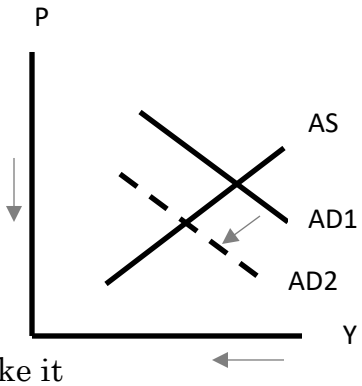
Expansionary policy can involve increases in Government spending, the money supply, or investment, as well as tax or interest-rate cuts or a weaker currency. Or, it could be the result of non-government factors. This policy can be drawn as an increase in Aggregate Expenditure in the **AE model**, although I tend to focus solely on the AS-AD model. The way I do it, only AD shifts for all types of policy (unless it

is a change in business taxes or something supply-related). Supply-side policy is treated as a special case.

Expansionary policy is drawn as a rightward shift in the AD curve. As a result, both GDP and prices increase. Unemployment should fall if GDP rises. This tradeoff between unemployment and inflation is important for policymakers, since something positive is combined with something negative. The inverse relationship between unemployment and inflation was called the *Phillips curve* in the 1960s, but the relationship was not shown as clearly after that.



Contractionary policy can involve decreases in Government spending, the money supply, or investment, as well as tax or interest-rate increases, or a stronger currency. It could be the result of non-government factors as well, such as a major storm that hurts a country's economy. It is drawn as a leftward shift in the AD curve, and inflation and GDP decline. (I tend to cheat and say "inflation" instead of "the price level" because deflation is rare, and because doing the model this way is much simpler than the shifts required to make it match reality.)



The details behind fiscal, monetary, and exchange-rate policy are explained next.

19. Taxation and Fiscal Policy

Fiscal Policy the use of government spending and taxation to directly influence macroeconomic outcomes. In the U.S., all levels of government spend and tax (the federal government, most states and some cities have an income tax, for example) but only the federal government enacts fiscal policy as defined here. Spending also differs by jurisdiction; cities and states pay for public schools, often with federal help in some cases.

Governments collect taxes for a number of reasons. These include to collect *revenue*, to *influence behavior*, and to *redistribute income*. Microeconomics discusses these in detail; cigarettes are taxed partly to discourage smoking, and partly for revenue that pays for government functions. Sometimes these effects are unintentional—some people criticize the income tax because it discourages work.

At the federal level, income taxes are just one revenue stream. The U.S. often runs a **budget deficit**, where government spending exceeds tax revenue ($G > T$). If a country has a **balanced budget**, ($G = T$); and if it has a **budget surplus**, ($G < T$). The national **debt** is the sum of past deficits; it is a *stock* variable.

One interesting formula is $Tax\ Revenue = Tax\ Rate \times Tax\ Base$, where the tax rate is a percentage of the item being taxed, and the tax base is the value of the item being taxed. A 10% sales tax on a $50 item results in $5 in revenue. Some cities, having lost the factories that made up their tax bases, have seen a loss of revenue and a reduction in services as a result.

Tax rates might depend on the tax base. The U.S. federal income tax is a **progressive tax**, where high income levels are taxed a higher rate than lower levels. A **proportional tax** has the same rate, regardless of the tax base. A **regressive tax** is one where low bases have higher rates. A "flat fee" is actually regressive; if everyone pays the same $100, for example, the share of income ($\$100/Y$) falls as income rises.

Supply-side economics postulates that high tax rates reduce the tax base when they penalize work and other economic activity. The **Laffer curve** graphs that tax revenue rises as the tax rate increases, but eventually starts to decline if taxes get too high. This type of policy advocates business tax cuts, which shift AS to the left, increasing GDP and lowering inflation.

Expansionary fiscal policy involves increases in *G* or decreases in household taxes (which increase Consumption). Economic stimulus is the term for policies designed to increase GDP and reduce unemployment. **Contractionary policy** is the opposite, and has the goal of lowering inflation. **Austerity policy** often aims to reduce debt by raising taxes and reducing government spending.

I usually focus less on fiscal policy, because it is rarely implemented in the United States (only in emergencies, such as the 2008 financial crisis, can Congress and the president act effectively, it seems). Fiscal policy also suffers from **time lags** in *recognizing* the need for policy, *implementing* needed measures, and waiting for them to *take effect*. Fiscal policy is also difficult for politicians, who wish to be reelected, to do anything but expand the economy (for that reason, monetary policy is left to appointed, but unelected, central bankers). In addition, international macroeconomics concepts show that fiscal policy can have weaker effects in a global economy.

20. Money and Monetary Policy

Even though money has no value in and of itself, it increases well-being in society. Money fulfills **three functions**: As a *medium of exchange*, a *unit of account*, and a *store of value*. The first is key: Money is used to facilitate transactions. The direct exchange of goods (known as **barter**) is difficult if the two sides of an exchange do not have the goods the other wants, but money is acceptable by both parties, so the product gets sold. Money is also used to value things such as wealth and the value of goods (and even GDP). And it holds value better than some things used in the past—such as cattle, which can get sick and die.

Money can be something that has *intrinsic value*, such as gold or silver coins (**commodity money**). The United States and most other country use paper (or electronic) money, which is not backed by anything other than trust in the government. This is known as **fiat money**.

While paper money also originated in China, it is said to have gotten its start in Italy when goldsmiths, who held onto the precious metal for safekeeping, began issuing receipts that were more convenient to use as a medium of exchange. This also led to the development of the banking system (from the Italian word *banca*).

The money supply also expanded by including currency as well as deposits. Banks profit by making loans and earning interest (which is typically a higher rate than they pay on deposits). Because they need to have at least some money available for withdrawals, they hold a fraction of deposits as **reserves**. This fraction is known as the **reserve ratio**. The size of this ratio affects the amount that can be lent out, so it affects the money supply.

Today there are various definitions of the **money supply** or **money stock**. The **monetary base** (MB) is currency in circulation plus reserves. A common definition of "narrow money" is **M1**, which is currency plus (checkable) deposits. In many ways, checking accounts are considered equivalent to cash. "Broad money" is **M2**, which includes M1 plus **time deposits** such as fixed-term certificates of deposit. It is less **liquid** than M1, since it cannot be converted to cash as easily, but larger in size, since it includes M1.

The money supply is usually controlled by central banks, such as the U.S. Federal Reserve. Its original function when it was instituted in 1913 was to serve as the *lender of last resort*, providing liquidity to banks

during a crisis. It has since expanded to include managing the overall macroeconomy.

Central banks such as the Fed typically have **three tools** to implement monetary policy. The first is the **reserve ratio**. Raising this lowers the money supply. The second is the **discount rate**, which is paid on loans directly from the Fed. Raising this rate results in fewer loans, and a lower money supply. The third, and usually most commonly used, is **open-market operations**, which involve the buying and selling of **bonds** to increase and decrease the money supply, respectively. While all types of governments and corporations can issue them, the Fed typically buys U.S. treasury bills.

There are number of mathematical formulas that can help explain these concepts. The reserve ratio (RR) affects the **money multiplier**, which helps a deposit expand beyond its original value. It is similar to the spending multiplier, with RR equivalent to the **marginal propensity to save** (MPS), or $(1 - MPC)$. Its formula is $mm = 1/RR$. If no cash is held (an extreme assumption), an RR of 0.5 could mean that an initial deposit of $1000 leads to a loan of $500, which is re-deposited, and $250 is lent out to another borrower. In the next round, $125 is lent out, and $125 is held in reserves. This continues for $62.50, $31.25 … and so forth.

This repeats until the last loan is close to zero. Adding up the loans, and the total amount = $2000, so the multiplier is 2. The bank's total reserves after all these rounds equal $2000 as well. If RR = 0.1, the multiplier is 10, because the "rounds" of spending are $1000, $900, $810, $729 … and so forth; this adds up to $10,000. Total reserves equal $100 + $90 + $81 … , or $1000. Lowering the reserve ratio increases the money supply. Changing it from 0.5 to 0.1 would increase the multiplier and put more money in circulation.

Open-market operations can be shown through the **balance sheet**. On the Assets side are things the central bank can own: domestic bonds, foreign bonds, and gold. On the Liabilities side are things the central bank issues: Here, currency and reserves (these add up to the monetary base). The two sides must balance: If the left-hand side increases, the right-hand side must increase.

Central Bank Balance Sheet

Assets	Liabilities
Domestic Bonds	Currency
Foreign Bonds	Reserves
Gold	

If the Fed purchases domestic bonds through open-market operations, its asset holdings increase. The

monetary base must increase as well. A sale of bonds will decrease the money supply. While some people refer to "printing money," increased money supply can be done by increasing bank reserves.

The other two items are important as well. Foreign bonds (or **foreign exchange**) can be bought to weaken a county's currency, or sold to strengthen it. While the U.S. does not hold much gold, a country might tie its money supply to gold under a **gold standard**.

One other useful equation is the monetarist **equation of exchange**, or the **quantity theory of money**. This is associated with Milton Friedman, who as a major figure in the Classical school of economics, but is useful in examining the link between money and output and inflation. The equation is written as $MsV = PY$, where Ms is the money supply and V is the "velocity" of money (the number of times each unit is spent; this is assumed to be constant). The right-hand side is equal to the price level times real GDP (together they equal nominal GDP).

According to Classical economic theory, Y is assumed to be fixed in the short run, so any increase in the money supply leads directly to inflation. This is the same as increasing AD with a vertical AS curve. Under Keynesian economics, increasing the money supply can lead completely to real GDP growth (in the extreme case), or more likely to a mixture of inflation and growth. This is similar to increasing AD with an upward-sloping AS curve.

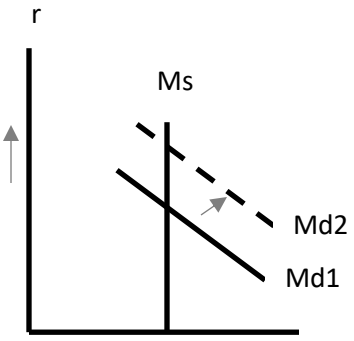
21. The Money Market and Interest Rates

Perhaps the most important price in macroeconomics is the **interest rate.** This is well-known as the price at which people borrow or lend money, but it has other macroeconomic definitions as well. It is the "price" of transferring money from the present to the future, for example (and represents how much people value the future). If you need money now, you pay for it, or you get paid to save it for later. It is the **opportunity cost** of holding money; even though money pays no interest, alternative investments do. Every dollar I hold means I cannot use those funds to hold bonds, for example. Bonds pay interest when they are sold at less than their *face value* (they are sold at a *discount*) and then are paid off in full at a later date.

The interest rate is also the payment to capital, which should equal the *marginal product of capital*. .Just like workers are hired to be productive, similar cost-benefit decisions are made regarding capital. I will only take out a loan to buy a car if I think it is worth the cost. (This is also related to bonds, which are often issued by corporations who wish to use the funds to expand their productivity.) High interest rates mean that only the highest-productivity capital gets purchased, so the amount of capital is lower. Lower rates mean more capital gets bought, since it is now less expensive. In macroeconomics, Investment equals the change in the capital stock (ΔK). If interest rates are lower, I goes up, so $C + I + G + (X - M)$, or AD, increases.

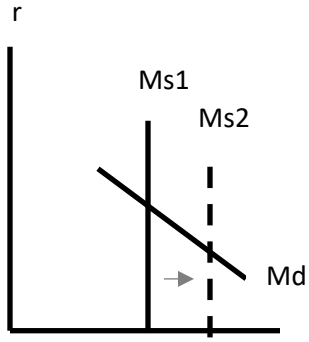
The *money market* has money supply and money demand, and the interest rate r as the "price" of money. Money supply is vertical because the quantity of money is chosen by the central bank *independent* of the interest rate. (If private banks issued their own money, they would use their assets to balance it, though. These would be their deposits—and they could get more deposits, and therefore more money supply, by paying more interest.)

There are three types of money demand. The first is called *precautionary demand*, which means that people hold more money "just in case" some unforeseen event requires it. *Speculative demand* means that, if interest rates are low, people hold fewer bonds. Instead, they hold more money, looking for better investment opportunities. As a result, the money demand



curve slopes downward. *Transactions demand* means that if people have more income, they buy more things—and need more money to do it. This makes the *Md* curve shift to the right, and interest rates should increase. If income declines, money demand shifts to the left.

The Federal Reserve can increase the money supply by buying bonds and conducting **open-market operations**. It is said that by doing so, they are "lowering interest rates." In practice, the Fed's Federal Open Market Committee lowers the target **federal funds rate**, which is what banks charge each other for overnight loans in the open market. The Fed then intervenes to cause this rate to go down to the new target.



Where the equation $MsV = PY$ also shows that this increase in the money supply can cause the price level and/or real GDP to increase, the "transmission mechanism" here is a little more complicated. With **expansionary monetary policy,** *buying* bonds causes the monetary base to increase, which increases M1 through the multiplier. Interest rates go down, leading to more Investment. AD shifts to the right, and P and Y should increase. This can be shown as:

$$Bonds \uparrow \rightarrow MB \uparrow \rightarrow Ms \uparrow \rightarrow r \downarrow \rightarrow I \uparrow \rightarrow AD \uparrow \rightarrow P \uparrow, Y \uparrow$$

Under **contractionary monetary policy**, exactly the opposite should occur. This is commonly done to lower inflation when the economy is growing rapidly.

22. Understanding Exchange Rates

The **exchange rate** is the price of one currency in terms of another. Since I teach a dedicated course in international economics—and because this usually comes right at the end of the semester—I usually mainly tie this concept to the Supply and Demand model from earlier in the course, and the AS-AD model from later on.

Currencies rates officially have a 3-letter code, and major ones (like the dollar, euro, yen, and pound sterling) have symbols. Exchange rates are often written out to four decimal places. They can be written in terms of either currency; both are reciprocals of each other. For example, if 100JPY = 1USD, you could write is as .01USD =1JPY. Or, you could write $E_{¥/\$}$ = 100 or $E_{\$/¥}$ = 0.0100, Sometimes generic "Home" and "Foreign" currencies can be expressed as $E_{H/F}$. Currencies can **appreciate** (gain value) or **depreciate** (lose value), often due to market forces. These movements can be expressed as percentage changes. If the yen goes from \$0.0100 to \$0.0110, we can say that the yen has appreciated by 10 percent.

A country's **trade balance** is a GDP component: $(X - M)$. If $X > M$, the country is running a **trade surplus**. If $X < M$, they have a **trade deficit**. This is balanced by buying and selling financial assets.

Weak currencies are expansionary and help a country's exports. They also decrease imports. Strong currencies are contractionary, increasing imports and decreasing exports. As the dollar strengthens, U.S. consumers and firms (which make up the majority of international foreign exchange transactions) are more likely to sell their own currency to be able to buy foreign products. This is like a Supply curve. If the dollar is weak, foreigners want to buy it so they can buy U.S products. This is a Demand curve. (One big concept is that these relationships are the same, only upside down!) This leads to a Supply-and-Demand graph for the **foreign exchange market**, with the exchange rate as the "Price." Increases in dollar demand lead to increases in E*.

An additional concept is the **real exchange rate**, which is adjusted for both country's prices: $q_{H/F} = E_{H/F}\frac{P^H}{P^F}$. This in terms of goods, not money, and is related to **purchasing power parity**. In theory, a good or basket of goods in one country should buy the same amount in the other. If not, E might be too high or too low, and the currency might be **overvalued** or **undervalued.**

23. Exchange Rates: Numerical Example

Here, a range of exchange rates are given: Mexican pesos per U.S. dollar. This reflects the historic range of these currencies in recent years. The dollar *appreciates* as you move down the table. The second column gives dollars per peso, which is the *reciprocal* of the first column. The peso *depreciates* as you move down.

The third column shows what a $100 product would cost to a Mexican buyer—this changes based on the exchange rate. This is important because as the dollar appreciates and the peso depreciates, the U.S. export (Mexican import) becomes more expensive.

The fourth column shows what a 1400-peso product would cost to a U.S. buyer. As the dollar appreciates and the peso depreciates, the U.S. import (Mexican export) becomes less expensive. *Changes in the exchange rate affect (X- M), and GDP*.

The final column calculates the percentage change in the MXN/USD rate. The first cell is blank because there is nothing above it to subtract.

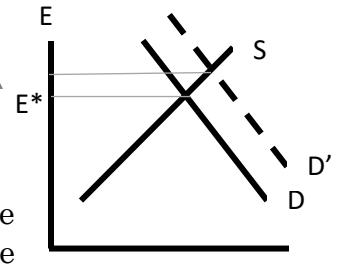
As the dollar appreciates, the third column value increases. This is like an upward-sloping Supply curve (a stronger dollar encourages dollar holders to purchase abroad, because dollars buy more). The fourth column decreases—but if you look at it upside down, a stronger peso means more Mexican purchasing power. This is like a Demand curve, as peso holders want to buy more U.S. goods (which are priced in dollars). The intersection of supply and demand is the price of currencies, or the exchange rate.

MXN/USD	USD/MXN	$100 in MXN	1400MXN in USD	% App
10	0.1000	1000	140.00	--------
12	0.0833	1200	116.67	20.00
14	0.0714	1400	100.00	16.67
16	0.0625	1600	87.50	14.29
18	0.0556	1800	77.78	12.50
20	0.0500	2000	70.00	11.11

24. Exchange-Rate Movements

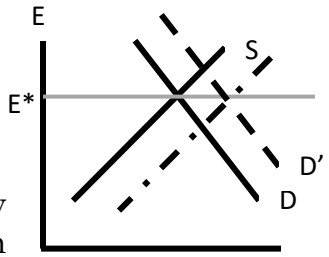
The foreign exchange market can have shifts in supply and demand that lead to changes in E*. This is actually somewhat overcomplicated, so in my advanced classes I use a different model. Here, I shift only Demand, although technically both curves should move. With a **floating exchange rate**, which moves with market forces, various economic and non-economic factors can move the exchange rate. Currencies are often modeled like other assets, such as stocks, which are driven by *fundamentals* and *expectations*.

The most important macroeconomic fundamental is the **interest rate**. If a country raises theirs, demand for their currency should increase as investors worldwide are attracted to the country's assets. The currency should rise in value. Other macroeconomic causes of an **appreciation** include GDP growth, low inflation, and decreases in the money supply. Positive changes in **expectations** ("good news," like a favorable election result) might cause the currency to appreciate as well. Causes of depreciation include lower interest rate, recession, high inflation, monetary expansion, or "bad news."



If a currency appreciates, the trade balance decreases, so AD shifts left. GDP (and inflation) decline, so this is considered **contractionary**. A currency depreciation is considered **expansionary**, as the trade balance improves and AD shifts right.

Some countries choose to have a **fixed exchange rate**, where target E is chosen and maintained by the central bank. This is done with **foreign exchange reserves**. If a country's market forces cause its currency to rise, the central bank buys foreign exchange, adding it to its balance sheet. This causes the money supply to rise, and keeps the currency low. A country can keep its currency from depreciating by selling foreign exchange. This decreases the money supply.



The equation $MsV = PY$ shows the problems this can cause, by raising P or lowering Y if Ms changes. For this reason, large countries like the U.S. have floating rates. Some small countries, or those closely connected to a trade partner, have fixed rates. As you might guess, most economists like markets, and prefer market-based exchange rates.