Measuring Macroeconomic Performance

Suppose that someone asked you to evaluate the performance of a major league baseball player—say, Jeff Bagwell. You are asked to evaluate how well he is performing now, and how his performance has changed over time. How would you undertake such an analysis? Well, you would probable examine things such as Bagwell's batting average, slugging percentage, on-base percentage, home runs per at bat, and many other statistics. You would evaluate how these statistics compare to other major leaguers, and how the statistics have varied over Bagwell's career.

Sports enthusiasts and statisticians have developed many statistics to measure the performance of baseball players. Similarly, macroeconomists and statisticians have developed many statistics to measure the performance of the economy. We shall introduce some of these macroeconomic statistics in this set of notes.

Some popular macroeconomic statistics measure:

- aggregate output: the value of total production of goods and services in the economy.
- aggregate income: the total amount of income received by all citizens in the economy.
- average price level: the average level of prices of a large number of goods and services produced in the economy.
- unemployment rate: the portion of the nation's adult population that cannot find work.
- Interest rates: Rates of return on loans (and the costs of borrowing)

Aggregating means "collecting and summing."

A product can be either a good or a service. A good is a tangible product, such as a hammer. A service is an intangible product, such as a psychiatrist's advice.

We shall discuss some specific statistics that measure output, income, prices, unemployment, and interest rates below. By following how these statistics change over time, we can gauge how well the economy is performing over time.

Measuring Aggregate Output

Perhaps the most popular measure of the performance of the economy is the measure of the total value of the goods and services produced in the economy—aggregate output. Indeed, when one discusses the "size" of an economy, one usually is referring to the value of the output produced in the economy.

The most popular measure of the aggregate output of an economy is known as Gross Domestic Product, also known as GDP:

Gross Domestic Product is the total value of all final goods and final services produced in the economy (over a specified amount of time, such as a year).

Let's dissect this definition:

- How do statisticians determine the value of a good or a service?

  Usually the selling price of the good or service is used as its value. (Why? Economists assume that if you willingly buy something, then it must have a value to you of at least the price that you paid for it. Otherwise, why would you voluntarily buy it?)

  Example 1: You buy a pizza for $10. The statistician counts the value of that pizza at $10 in the GDP.

- *What's a final good and what's a final service*?

  One can categorize a good or a service into two types: final or intermediate. An intermediate good or an intermediate service is used as an ingredient in another good or service. In contrast, a final good or a final service is never used as an ingredient in another good or service.

  Example 1: You buy a pepperoni pizza. The pizza is a final good—its value is included in the GDP calculation. The cheese, flour, tomato sauce, etc. are intermediate goods whose value is not directly included in the GDP calculation

  Example 2: You buy a new Ford Taurus, made in Detroit, to drive around town. The Taurus is a final good—its value is included in the GDP. The tires, radio, leather seats, headlights, etc. are intermediate goods whose value is not directly included in the GDP calculation.

  Example 3: You buy a Toshiba digital camera made in Japan. This good is excluded from the U.S. GDP calculation, since it is not produced in the U.S. economy.

Why aren't intermediate goods/services included directly in the GDP calculation? Because the values of intermediate goods/services are already reflected in the price of final goods/services. Consider a Ford Taurus, for which you paid $16,000. Would you have paid $16,000 if the car had no tires or seats? No way! The values of the tires, seats, and all other intermediate goods contained in the Taurus are already reflected in the selling price of the Taurus.

Calculating GDP

There are many ways to calculate GDP. We'll eventually discuss three specific ways to calculate GDP; all of these calculations, if done without error, should arrive at exactly the same value for GDP. First, here's the most obvious way to calculate GDP:

The product approach: the easiest way to explain this method is to do an example for a hypothetical (i.e. fake) economy. So let's pretend that in the fake economy of Publand, only two final goods (and no final services) were produced in 1999—pepperoni pizzas and root beers. More specifically, in 1999 400 pizzas were produced and sold for $10 each, and 1000 root beers were produced and sold for $2 each.

Publand's 1999 GDP	= total value of pizza	+ total value of root beer
	= $10 x 400	+ $2 x 1000
	= $4000	+ $2000
	= $6000	

Next, let's consider another way to calculate GDP, sometimes know as the expenditure approach. Suppose we asked each and every buyer in Publand how much money he/she spent on pizza and root beer in 1999, and we summed the total (hey! we just aggregated!). What total value would we get? Yes….$6000! (This assumes that there were no exports of pizza or root beer out of Publand.)

The general idea: All products are either purchased or build up in a firm's inventories.

So, we can calculate GDP indirectly by aggregating all of the expenditures of all buyers of goods and services produced in the economy, then add any increase in firms' inventories. This is commonly done by separating expenditures into categories as follows:

GDP = sum of all expenditures on final goods and services

GDP = personal consumption expenditures
+
gross private domestic investment
+
government purchases of final goods and services
+
exports of final goods and services
–
imports of final goods and services

Abbreviated:

Y = C + I + G + NX

"Y" means "GDP"

"NX" means "net exports": Exports minus imports

Let's discuss these different categories of expenditures:

Personal consumption expenditures (also known as consumption, abbreviated C):

This is the sum of all expenditures on final goods and services by consumers, excluding purchases of new housing.

Example: Your purchases of pizza, your rent of apartments, your college tuition payment, your digital camera purchases—all are included in this category. If you buy a new house—it ain't in this category.

Since houses aren't really consumed—they are usually still standing long after the consumer is gone—houses are not included in the consumption category.

Gross private domestic investment (also known as investment, abbreviated I):

This category includes:

- Nonresidential investment: Purchases of final goods and services by firms
- Residential Investment: Purchases of new housing
- Inventory investment: Increase in the aggregate value of firms' inventories. (If inventories decrease, then inventory investment is negative.)

Examples: If Ford buys a robot, then it's included in nonresidential investment. If you buy a new house, then it's in residential investment. If Compaq's inventory of unsold computers rises, then it's in inventory investment.

Careful! The term Investment is used differently by macro-economists than it is by people in the financial world who trade stocks and bonds!

Government Purchases of Final Goods and Final Services (abbreviated G):

Any time that any government in the economy—Federal, state, or local—buys a final good or a service, then it's included in this category.

(Warning! When government gives money away without buying anything, e.g. when it pays unemployment benefits, this is known as a transfer payment; it is not a purchase, and therefore transfer payments are not directly included in G or in any category of expenditures.)

Examples: If government buys a tank or pays to build a highway, then these are included in G. If government pays Social Security benefits, then these are not

included in G.

Exports of final goods and final services (also known as Exports):

When a buyer located in another country buys a final good or service that was produced in the U.S. then this is part of U.S. exports.

Examples: If a Japanese consumer buys an IBM server made in Alabama, then it's in U.S. exports. If a Canadian buyer buys a Honda Accord made in Ohio, then it's included in U.S. exports.

Imports of final goods and final services (also known as Imports):

Notice that imports are subtracted in the GDP calculation. Why? Hey, I'm so glad that you asked. Here's the reason. Remember, when we calculate GDP we're trying to calculate the production of final goods and services produced in this economy; we want to exclude imported stuff. Well, here's the thing: included in C, I, and G are imports, because consumers firms and governments buy imported things. We need to subtract these imports if we want a calculation of GDP. So we do it here, by subtracting IM. Fascinating, ain't it?

Example: When a consumer buys a digital camera, it's included in imports. When a firm buys a foreign robot, it's in imports. When a government buys a foreign camcorder, it's in imports.

If we subtract imports from exports, We get net exports. If net exports is a negative number, then the economy has a trade deficit.

A real world example of the expenditure approach:

Here's U.S. GDP for 1999. (The U.S. economy is by far the world's largest economy; that is, it has the largest GDP by far. No other country's GDP is even half the U.S. total.)

U.S. 1999 GDP (rounded, in $billions) $= C + I + G + NX$
$= 6268 + 1650 + 1634 + (990 - 1244)$
$= 9299$

That's 9 trillion, 299 billion dollars!

And now, a third way to calculate GDP: the Income Approach

Suppose that you run a business, and folks spend a lot of money buying your products. What do you do with all of that money? All of these:

1. Pay your workers and suppliers—income for them
2. Keep some of the money as income for yourself
3. Pay sales taxes to government
4. Replace or repair equipment that's wearing out

Well, Items 1 and 2 above are *earned* income. Item 3 is a type of indirect business tax. Item 4 is called *depreciation*.

Let's generalize this example of one firm to the whole economy. Remember, that GDP—the total value of the output of all producers, is the sum of all money that firms take in from people buying their products. What happens to this GDP? Well, most of it is paid as income to people—the national equivalent of items 1 and 2. Some of it is paid as indirect business taxes to government. The rest is used to replace or repair worn out equipment.

We can use the information in the above paragraph to derive a specific relationship between GDP and national income. First, a definition of national income:

National income is income earned by the economy's citizens for supplying factors of production (such as labor) to producers.

So here's the thing. When firms pay out money that is received by Americans as income, most of it comes from companies located in the U.S. But, since some American-owned companies make income abroad and since some Americans work aborad, some of Americans' national income comes from abroad; this is called net factor payments from abroad. (More precisely, this equals payments for factor income from the rest of the world, minus payments of factor income from the U.S. to the rest of the world)

What's the term used for the payments needed to replace worn out equipment? Depreciation, also known as Consumption of Fixed Capital! More specifically, depreciation is the reduction in value of installed capital equipment.

Now that we have these definitions straight, we're ready to show where the GDP goes—that is, what the producers do with the money they receive for selling their products:

GDP = national income
- net factor payments from abroad
+ indirect business taxes
+ depreciation (a.k.a. consumption of fixed capital)

Notice that if we rearrange the above equation we get another way to express the relationship between national income and GDP:

national income = GDP + net factor payments from abroad
- indirect business taxes – depreciation

Hey, who cares about the relationship between GDP and National Income? Well, it ain't the most important thing in life. The most important thing in life is to have an ample supply of peanut butter M&Ms on hand when typing notes. But I digress. We'll see the importance when we start to build models of the economy later in the semester. One goal is to increase the incomes of citizens—increase the national income—thus increasing the material standards of living of citizens. Perhaps you can tell from the last equation that if we can increase the level of production in the economy—the GDP—then we will also probably increase national income, making people materially better off.

Indirect business taxes are taxes paid by firms on products sold; sales taxes and gasoline taxes are examples.

A factor of production is anything that a firm needs to produce a product that is not an ingredient in the product. Examples: labor, robots, manufacturing plants.

Warning! Do not confuse national income with private disposable income, a measure of income that we'll discuss later in these notes.

A Closer Look at National Income

You're dying to know the five major components of national income, right? Here they are. (All of these are considered *earned* income; that is, people are supplying something of value to producers in exchange for this income)

National income = compensation of employees + proprietors' income
+ corporate profits + net interest + rental income

Another Measure of Income: Private Disposable Income

Most of us work, and we know that there is a difference between the amount of income that we earn and the amount that we have left over to spend once government gets involved:

Private disposable income is income available for spending and saving by households. (This thing is also known as *disposable personal income*.)

What is the relationship between Gross Domestic Product and Private Disposable Income? Glad you asked. The government takes some of our GDP away as taxes. But they give us some unearned income in the form of transfer payments. In addition, we may receive some income from abroad. Finally, we receive interest from lending dollars to the government to finance government's debt.

So, to go from GDP to private disposable income we must:

--subtract taxes
--add net factor payments from abroad
--add interest earned from government loans
--add transfer payments

Abbreviated: private disposable income = Y – T + NFP + INT + TR

Once individuals have this private disposable income, what do they do with it? If we simplify a bit from reality, then they can do one of two things:

1. Spend it (This is consumption!)
2. Save it (This is private savings!)

This equation summarizes what individuals do with their private disposable income:

private disposable income = $C + S_{pvt}$

Preview of coming attractions: Notice that if government cuts taxes, this leaves individuals with more private disposable income. They will likely spend some of this income, causing higher consumption. Since consumption is a component of GDP, GDP rises. We will see these cause & effect relationships more clearly later in the semester when we build our models of the economy.

Private savings, again:
Let's rearrange that equation for private disposable income on the bottom of the previous page to get an equation for private savings:

First, I repeat the equation here:

private disposable income = $C + S_{pvt}$

Now, let's recall how we derived private disposable income from GDP (Y):

private disposable income = $Y - T + NFP + INT + TR$

Now, let's substitute information from one equation into the other:

$Y - T + NFP + INT + TR = C + S_{pvt}$

Finally, let's get S_{pvt} by itself on the left:

$S_{pvt} = Y - T + NFP + INT + TR - C$

Government Savings
We know that if individuals spend less than they take in then they have some private savings. Well, there is a similar concept for the government sector known as government savings.

Here's the deal: Government takes in "income" in the form of taxes (and fees, which we will largely ignore). They spend this money in three ways: government purchases, transfer payments, and paying interest on their debt. So, whatever tax revenue that government has left after they do these three types of spending is known as government savings. (The popular term in society is the "budget surplus.")

When government savings, S_{govt}, is negative, then that's a budget deficit.

$S_{govt} = T - G - TR - INT$

National Savings
National savings, S, is the sum of private savings and government savings:

$S = S_{pvt} + S_{govt}$

Now, let's substitute information from the two equations in red on this page—the equations for Spvt and Sgovt—to get another equation for national savings:

$S = (Y - T + NFP + INT + TR - C) + (T - G - TR - INT)$

Notice in the above equation that the T, INT, and TR are added then subtracted; in other words, they sum to zero and cancel each other out. So we're left with:

$S = Y + NFP - C - G$

National Savings, Investment, and the Current Account Balance

You might think that our level of national savings in the economy has nothing to do with our trade deficit. Ha! Let me rewrite the national savings equation from the last page here:

$$S = Y + NFP - C - G$$

Now, let's get rid of the Y in the above equation. Remember, Y is short for GDP, and we saw earlier how GDP is the sum of expenditures on the economy: $Y = C + I + G + NX$. So let's substitute C+I+G+NX in place of Y in the national savings equation:

$$S = C+I+G+NX + NFP - C - G$$

Notice that the C and G cancel out in the equation, leaving us with:

$$S = I + NX + NFP$$

Let's recall what those four symbols are: S is national savings, I is gross private domestic investment, NX is exports minus imports of goods and services, and NFP is net income received by Americans from abroad. Now let's apply this equation to current conditions in the U.S:

The U.S. has a very low savings rate (low S), and low net income (low NFP) from abroad. But we want a high level of investment (high I) in this country. Well, the only way that we can have all three things is for NX to be negative—that is, to have a big trade deficit! Fascinating, ain't it? We'll investigate this fact more thoroughly when we build models of the economy later in the semester.

By the way, there's a name for NX + NFP: the current account balance (abbreviated CA). This is the sum of our net exports and the net amount that Americans receive as income from foreigners.

$$CA = NX + NFP$$

If we substitute CA into our national savings equation, we get:

$$S = I + CA$$

A Closer Look at Private Savings

Let's take another look at private savings, by rewriting the last equation, recalling that national savings equals the sum of private savings and government savings:

$$S_{pvt} + S_{govt} = I + CA$$

Now let's get private savings by itself on the left:

$$S_{pvt} = I - S_{govt} + CA$$

Now let's interpret the above equation: Private savings is split three ways: it pays for investment, it pays for the budget deficit, and the rest must equal the current account balance.

One definition of nominal is "normal."

And now, a completely different topic

Measuring Performance Over Time: Real Statistics are Better than Nominal Statistics

Here's a brief example that illustrates the difficulty in measuring changes in the performance of the economy (or of any other thing that is measured in dollars) over time:

In 1960 an entry level accountant earned $10,000 annually. In 1999 a worker at McDonald's earned $12,000 annually. Whose income had greater purchasing power? Answer: the accountant in 1960. Why? Because prices were much, much higher in 1999 than in 1960.

Inflation—the general rise in the average level of prices over time—makes it difficult to compare statistics measured in dollars over time. Everyday statistics observed by everyday people—known as nominal statistics by economists—have a fatal flaw—they change due to inflation. One should NOT use nominal statistics to try to gauge changes in the economy (or anything measured in dollars) over time.

Hey…it's difficult to measure changes in the economy over time, but it ain't impossible—hah!!! Economists have developed a technique to deflate nominal statistics—to remove the effects of inflation from changing the statistics over time. They call these deflated statistics real statistics.

Moral: Use real statistics to measure changes in economic performance over time. Do not use nominal statistics.

Deflating Nominal Statistics to Real Statistics: An Example, Using GDP

Just how do economists deflate nominal statistics into real statistics? We shall demonstrate, using GDP of a hypothetical economy as an example. Keep in mind, however, that this same technique can be used to deflate any statistic measured in dollars from nominal to real—consumption, wages, national income, etc.

Consider the fake economy of Sourland, where only two final goods and/or services are produced—pickles and lemons. In the table below, I list the quantity of pickles and lemons produced during three recent years, along with the price per pickle and price per lemon in each of those years.

year	Quantity of pickles	price per pickle		quantity of lemons	price per lemon
1997	10	$3		2	$7
1998	20	$4		4	$9
1999	20	$5		4	$11

First, let's calculate *nominal* GDP for each year. (Later, we'll remove the effects of inflation, calculating *real* GDP for each year.) Remember, nominal GDP for a year is the total value of the production of that year, which could have been observed and calculated by anyone in that year. *Nominal GDP is calculated using the prices of the goods/services in the year that they were produced.*

1997 nominal GDP = Value of pickles produced in 1997 + value of lemons produced in 1997
= (10 x $3) + (2 x $7) = $44

1998 nominal GDP = Value of pickles produced in 1998 + value of lemons produced in 1998
= (20 x $4) + (4 x $9) = $116

1999 nominal GDP = Value of pickles produced in 1999 + value of lemons produced in 1999
= (20 x $5) + (4 x $11) = $144

We'd like to be able to use GDP measured over the years to measure how fast the economy is really growing over time—that is, how fast the actual production of goods and services is growing over time. Perhaps you can see, using our Sourland example, that *we should NOT use nominal GDP to measure how fast production is growing over time*. Let me explain:

When the value of a statistic doubles, it grows by 100%. Sourland's economy grew by 100% from 1997 to 1998

Indeed, '97-'98 nominal GDP growth = ($116-$44)/$44 = 1.64, or 164%

Suppose we want to measure how much greater production was in Southland in 1998 compared to 1997. We can actually figure this out, in this simple fake economy, without any GDP statistic. Just look at the table on the previous page. Production of pickles doubled from 10 to 20 from 1997 to 1998, and production of lemons also doubled (from 2 to 4) from 1997 to 1998. Hence we can conclude that the economy doubled in size from 1997 to 1998.

But look at the nominal GDP statistics for 1997 and 1998: nominal GDP grew from $44 to $116—much more than double! If we were dumb enough to use nominal GDP as a true measure of production, then we would get an overstated amount of growth in production compared to the actual growth amount! Oh, what a disaster! It's worse than being on the Titanic with Britney Spears and those 'Nsync dudes!

We get similar problems if we try to use nominal GDP to measure Sourland's growth from 1998-1999. Looking at the table on the previous page, we can see that production was exactly the same in 1999 as it was in 1998—20 pickles and 4 lemons. Yet nominal GDP grew from $116 to $144 from 1998 to 1999. If we were dumb enough to use nominal GDP to measure GDP growth, then we would mistakenly conclude that the economy grew from 1998-1999 when in fact it did not. Oops…I did it again!

Let's avoid this disaster—remember: never use a nominal statistic to measure changes over time! Instead, let's develop a real statistic—real GDP. It's not too difficult; to remove the effects of inflation from real GDP, we freeze the prices of all products to equal their values in a fixed base year:

In the real world, one wants a fairly recent base year. But one can't change it

When calculating real GDP, the values of goods and services are frozen at their prices in a chosen base year—no matter when the goods and services are produced.

Let's calculate real GDP for Sourland. We need to pick a base year. I shall randomly pick 1997 as the base year. In 1997 pickles were priced at $3 each; hence we shall value each pickle at $3 no matter when it was produced. Similarly, in 1997 lemons were priced at $7 each; hence we shall value each lemon at $7 no matter when it was produced. So, real GDP in each year is:

1997 **real** GDP = Value of pickles produced in 1997 + value of lemons produced in 1997
= (10 x $3) + (2 x $7) = $44

1998 **real** GDP = Value of pickles produced in 1998 + value of lemons produced in 1998
= (20 x $3) + (4 x $7) = $88

1999 **real** GDP = Value of pickles produced in 1999 + value of lemons produced in 1999
= (20 x $3) + (4 x $7) = $88

Oh, the joys of being alive! Notice how real GDP doubled from 1997 to 1998? This is the correct measure of the growth of the economy, since pickle and lemon production doubled from 1997 to 1998. Notice also that real GDP remained constant from 1998 to 1999? This is also a correct growth measure, since pickle and lemon production remained constant from 1998 to 1999.

Moral repeated: Use real statistics—NOT nominal statistics—when measuring the performance of a variable over time. This moral holds true not only for GDP, as in our Sourland example, but also for income, wages, consumption, profits, and anything else that's measured in dollars.

too often, for practical reasons.

Notice how the value per pickle is fixed at $3 and lemons at $7—their prices in the base year of 1997.

Notice also that real GDP equals nominal GDP in the base year. This is logical, since both measures are using 1997 prices in their calculation.

Measuring Inflation

We know that prices rise over time, and we'd like to measure how fast prices are rising, on average, over time. When we do this, we are measuring inflation:

Inflation is the increase in the average price level of a basket of goods and services over time.

"Basket" just means "group"

To measure inflation, clearly we need somehow to measure the average price level of a basket of goods over time. When we do this for a specific basket of goods and services, we are creating a price index:

A price index measures the average price level of a basket of goods at different points in time.

Every price index has a base year; usually, the index is constructed so that it equals 100 in the base year. As prices rise over time, the value of the price index also rises.

In the U.S. there are a number of different price indices calculated by the U.S. government (and many more calculated by nongovernment economists). I shall mention three here:

1. The consumer price index (CPI) measures the average price level of approximately 10,000 goods and services consumed by the "typical" urban consumer.

2. The (implicit) GDP deflator measures the average price level of all final goods and services produced in the economy.

3. The chain-weighted GDP price index is a more accurate (compared to the GDP

deflator) way to measure the average price level of all final goods and services produced in the economy.

In a real economy, there isn't one inflation rate; there are as many inflation rates as there are price indices.

How are these price indices constructed? It ain't witchcraft. Let's look at the 3 price indices more closely:

The CPI

(The discussion below follows the textbook; the textbook gives an oversimplified description of how our government calculates the CPI. I'll write more on this oversimplification later.)

The CPI is a weighted average of 10,000 goods and services, which were determined (using a Consumer Expenditure Survey) to be purchased by non-rural consumer. Each good or service is given a weight in the CPI based upon the percentage of the typical consumer's budget that was spent on the good or service in the year that the survey was done (the CPI's base year). Specifically (and simplified),

$$\text{CPI in year X} = \frac{\text{Value of } \textit{base year} \text{ basket of goods using year X prices}}{\text{Value of } \textit{base year} \text{ basket of goods using base year prices}} \times 100$$

This CPI is an example of a fixed-weight price index. Why? Because to calculate inflation in any year, one calculates the value of the basket of goods that the consumer bought in the base year. One *never changes the basket of goods*! This, despite the fact that the consumer is no longer buying the exact same basket of goods; he/she is buying more of some goods, fewer of other goods, and he/she is also buying some goods that didn't even exist in the base year.

Perhaps you can see that a fixed weight price index may miscalculate the true inflation rate. Indeed, it may overstate the inflation rate. Here are 2 reasons why:

Substitution bias: There is a natural tendency for consumers, over time, to reduce purchases of goods whose prices are rising faster over time, and to increase purchases of goods whose prices are rising more slowly over time. The consumer's basket of goods changes over time, as buyers substitute away from high-priced goods; this reduces the negative effects of inflation on the buyer. But a fixed-weight index keeps the basket of goods constant, missing this important substitution effect.

Mistaking Quality Improvements for Inflation: Example: In 1999 the average selling price of a PC actually rose compared to the previous year. The CPI will record a price hike for the PC portion of the price index. But wait! The average PC in 1999 was much more powerful than its 1998 counterpart; at least some of the price hike, therefore, was due to improvements in quality. A price hike due to a quality improvement is not inflation (just as it's not all inflation when you trade in your

$2000 1982 Chevy Vega for a $25,000 Toyota Avalon)—it's merely a sign that a consumer is willing to pay more to get a higher quality product. Moral: price hikes caused by quality improvements should NOT be counted as inflation, but they are counted in a fixed-weight index.

(And now, defense of the U.S. CPI: It used to be true that the U.S. CPI was a fixed weight price index. But, in response to criticisms by economists and others, government workers have modified the CPI to correct for some of its problems. It is unfair today to characterize it as a purely fixed-weight price index. Still, some economists believe that the modern CPI overstates inflation, by perhaps ½% per year.)

The (Implicit) GDP Deflator

The GDP deflator is fairly simple to calculate:

GDP deflator in year X = (Nominal GDP in year X / Real GDP in Year X) x 100

Or, if you prefer, you can write the above equation as:

$$\text{GDP deflator in year X} = \frac{\text{Value of } \textit{year X} \text{ basket of goods using year X prices}}{\text{Value of } \textit{year X} \text{ basket of goods using base year prices}} \times 100$$

This GDP deflator is an example of a variable-weight price index. Why? Because to calculate inflation in any year, one calculates the value of the basket of goods that the consumer bought in that year. When one changes years one *always changes the basket of goods*!

You might think that changing the basket of goods to reflect actual changes in production is a good thing, and it is better than using fixed weights. But…there is a problem which may cause a variable weight price index to understate inflation:

Reverse substitution bias: Suppose that the price of a product soars, resulting in reduced purchases of the product. This harms buyers, and as a result they buy less of the product this year relative to last year. Well, the variable weight index does not capture the harm that this reverse substitution causes, since it only looks at the current year's purchase of the product (which is smaller, giving it a smaller weight in the price index). Thus the weight for goods whose prices rise is too small in a variable weight price index, so the price index understates the inflation resulting from price hikes in these products.

Hey! Let's use our Sourland example to calculate a price index for Sourland—the GDP deflator! For ease of exposition, in the table below I repeat the calculations that we did previously for Sourland's real GDP and nominal GDP:

year	nominal GDP	real GDP	GDP deflator
1997	$44	$44	($44/$44) x 100 = 100
1998	$116	$88	($116/$88) x 100 = 132
1999	$144	$88	($144/$88) x 100 = 164

Notice that the GDP deflator equals 100 in 1997—the base year. Let's use the GDP deflator to calculate inflation rates for Sourland. (An inflation rate is the percentage change in the average price level over some amount of time.)

1997-1998 inflation rate = (132 – 100) / 100 = .32 or 32%

1998-1999 inflation rate = (164 – 132) /132 = .24 or 24%

1997-1999 cumulative inflation rate = (164 – 100) / 100 = .64 or 64%

<u>The Chain-Weighted GDP price index</u>

We've seen some problems that arise when using fixed or variable weight price indices. Recently the government has been using a chain-weighted price index to calculate the increase in prices of goods & services produced in the U.S. This index uses a geometric average of the baskets of goods from recent years to determine inflation:

$$\text{Chain-weighted GDP deflator in year X} = \frac{\text{Value of } \textit{geometric average} \text{ basket of goods using year X prices}}{\text{Value of } \textit{geometric average} \text{ basket of goods using base year prices}} \times 100$$

This is the most accurate way to measure inflation. We shall skip the mathematical details.

<u>Inflation in the U.S.:</u>

The annual inflation rate in the U.S. has averaged between 2% and 4% for most years during the late 1960s, late 1980s and 1990s. In the 1970s and early 1980s, however, inflation rates were sometimes much higher; in 1980, for example, the inflation rate, measured using the CPI, was 13.5%.

Some U.S. CPI numbers:

year	U.S. CPI
1913	10.0
1950	25.0
1970	39.8
1983	100
1995	151.5
1996	155.8
1997	159.9
1998	162.3
1999	165.4

That's right: it's Clark Kent

This Dude Worries About Inflation. Who Is He?

Costs of Inflation:

What's so bad about inflation?

Exception: hyperinflation, defined as "really high" inflation (say, 100% or more annually) does erode purchasing power. The only cause of hyperinflation: government printing way too much money.

Myth: Inflation erodes purchasing power

It is simply not true that inflation systematically erodes purchasing power over time. Don't believe me? Compare the 1913 and 1999 CPIs for the U.S. Prices today are 16 times higher today than they were in 1913. Yet we all know that Americans have a much higher purchasing power today than in 1913. You see, inflation pushes up not only prices, but also nominal incomes.

True: Inflation has menu costs

If prices rise, business must periodically alter the price lists that tell their customers how much their products cost. This is a waste of valuable resources, known as menu costs.

True: Inflation has shoe leather costs

When inflation is high, interest rates tend to rise. But of course, if you have cash in you wallet, it earns zero interest. So during times of high inflation, people keep more of the wealth in interest-bearing accounts and less in their wallets. But when they need money to spend, they have to go to their financial institution to get cash. This results I far more trips to the financial institution than under low inflation conditions. What a waste of valuable time. This is known as shoe leather costs.

True: Unexpectedly HIGH inflation redistributes purchasing power from lenders to borrowers.

Suppose you want to buy a $10 pizza but have no cash. So you ask Grandma for a $10 loan, which you promise to repay next week. Grandma was about to buy her own pizza, but because she loves you, she lends you the $10 and you eat the pizza.

Unexpectedly, all prices suddenly double (so a pizza costs $20).

Now when you repay Grandma, she can't buy a pizza! In effect, you borrowed 1 pizza's worth of money from her and only repaid her ½ pizza's worth of money.

Grandma, the lender is worse off. You, the borrower, are better off.

(If you have a lot of student loans with fixed interest rates, like me, then you want inflation to be high. Or if you have a big mortgage with a fixed interest rate, you want inflation to be high. Remember: inflation will probably not erode your earnings, but it will reduce the burden of your debts.)

True: Unexpectedly LOW inflation redistributes purchasing power from borrowers to lenders.

Suppose you want to buy a $10 pizza but have no cash. So you ask Grandma for a $10 loan, which you promise to repay next week. Grandma was about to buy her own pizza, but because she loves you, she lends you the $10 and you eat the pizza.

Unexpectedly, all prices suddenly fall by 50% (so a pizza costs $5).

Now when you repay Grandma, she can buy 2 pizzas! In effect, you borrowed 1 pizza's worth of money from her and only repaid her 2 pizza's worth of money.

Grandma, the lender is better off. You, the borrower, are worse off.

Very True: High inflation is also unstable, making planning difficult, hampering long term economic growth.

This is probably the most burdensome problem with inflation. When it is high, it is unstable, and businesspeople have difficulty making plans because they do not know how high prices and wages will be in the future. In effect, high inflation increases uncertainty; this tends to reduce long term economic growth.

Unemployment

What is it:

To define the unemployment rate, we must also define the terms *unemployed*, *employed* and *labor force*:

A person is officially unemployed if he/she meets all of the following criteria:

1. 16 years or older
2. Not working at all for pay (not even for an hour a week).
3. Seeking work

A person is officially employed if he/she meets all of the following criteria:

1. 16 years or older
2. Working for pay

The labor force is the sum of the officially unemployed and officially employed

Labor force = employed + unemployed

Now, let's define the unemployment rate:

Unemployment rate = unemployed / labor force

Example: U.S. unemployment rate, July 2000:

= 5,650,000 / 140,399,000 = .0402 , rounded to 4%

Notes: The official unemployment rate is an imperfect measure of the current state of the labor force, since it does not account for

--discouraged people who have given up looking for work
--people working part time who would rather be working full time
--people working at jobs that do not suit their skill levels

Why are people unemployed?
Sometimes economists categorize the source of unemployment into one of the following (somewhat arbitrary) categories:

Categories of unemployment:

Structurally unemployed: people who have no skills to suit virtually any available type of job.

Frictionally unemployed: Well-qualified new entrants to the work force and well-qualified people between jobs who are searching for work. (This is sometimes known as *good* unemployment, because these people are looking for a job to suit their skills—this is good for them and good for the economy.)

Cyclically Unemployed: When there is insufficient national production (GDP) to employ all well-qualified people. This is the type of unemployment that concerns macroeconomists.

Note: The "best" unemployment rate is certainly not 0%, since one does not want to eliminate all frictional unemployment; it is good for people to spend time finding a job to match their skills, rather than taking the first job that comes along.

Full Employment:
When the economy is functioning well, there is sufficient GDP so that all people with good job skills who want to work are either working or can find work if they look for a reasonable amount of time. Full employment is the lowest level of employment at which cyclical unemployment is zero.

The full employment unemployment rate (also known as the natural unemployment rate) is the highest unemployment rate at which cyclical unemployment is eliminated.

Full employment GDP (also known as potential GDP) is the lowest level of GDP at which cyclical unemployment is eliminated.

Note: When the economy is operating at full employment, the unemployment rate is not zero. Only cyclical unemployment is zero; all other types of unemployment may be at nonzero levels.

Costs of cyclical unemployment:

1. Output lost forever. When there is cyclical unemployment, people with good job skills are idle—unused. This is a waste of valuable resources, resulting in lower production that can never be regained (since one cannot turn back time—alas!).
2. UnAmerican? Americans like to believe that each individual can succeed if he/she puts enough effort into life. This ain't true when there's cyclical unemployment, since many people who have worked hard to acquire good job skills cannot find any job, despite their best efforts.

<u>Macroeconomic Goals: 0% unemployment and 0% inflation? No!!!</u>
One might think that government should set a goal of 0% unemployment and 0% inflation, to rid the economy of the costs of these evils. But no!

--Some unemployment (frictional is good)

--As we'll see in detail later, some methods that government has to reduce unemployment result in higher inflation in the short run.

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Interest rates

We all know that an interest rate is a rate of return promised by a borrower to a lender. But can we adjust interest rates for inflation? No! I mean, yes!

Nominal interest rates: The interest rates that you see every day, at the bank, on the financial cable channel, etc. These are unadjusted for inflation

But, the real rate of return on a loan—that is, the increase in your purchasing power if you make a loan—is only the portion of the interest rate that you earn above the inflation rate:

Real interest rate = nominal interest rate – inflation rate

Let's rewrite the above equation using the textbook's symbols:

real interest rate = $i - \pi$

Interest rates and the future

If you borrow or lend money today, one thing that you must consider is how you expect that inflation will be in the future. A loan at a 10% nominal interest rate is a great deal for a borrower if you expect that the inflation rate will also be 10%--in essence, you will sacrifice no purchasing power if you get this loan. But the same nominal 10% interest rate sucks if you expect the inflation rate will be 2%, since you will be sacrificing 8% purchasing power by getting the loan.

Anyway, the point is that you must have a forecast of the inflation rate if you will engage in borrowing or lending today. This forecast of the future inflation rate is known as the expected inflation rate. Knowing this, you can also forecast the expected real interest rate:

Expected real interest rate = nominal interest rate – expected inflation rate

Let's rewrite the above equation using the textbook's symbols:

$$r = i - \pi^e$$

Well, we've defined a lot of terms and seen their relationships. We're ready to build models of the economy, beginning in the next set of notes.