Chapter 2: Measuring the Macroeconomy

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Questions

1. What key data do macroeconomists look at?

2. How are key macroeconomic data estimated and calculated?

3. What is the difference between "nominal" and "real" values?

4. How are stock market values related to interest rates?

5. How are interest rates related to the price level and the inflation rate?

5. How is unemployment related to total production?

6. What is right—and what is wrong--with the key measure of economic activity, real GDP?

2.1 The Importance of Data

Economics is a *social* science: it is about us, about what we do. Thus it shares with other social sciences one important source of information: introspection. We can ask ourselves "Why did I do that?" or "If I had done that, what would I have been thinking?" We can ask other people, and listen to their answers ("I did that because…"). In most of the other social sciences, the overwhelming source of information is introspection--either our own or other people's.

But economists are in a better position than most other social scientists as far as their sources of information are concerned. Everything that passes through the economy is priced and sold. Thus economists have quantitative data to work with: prices, quantities, and values. Having quantitative data allows economists to do more than many other social scientists. They can use theories to make not just qualitative but quantitative forecasts ("The change from Carter to Reagan-era fiscal policy reduced the growth rate of the U.S. economy by 0.3% per year…"). With data they can test theories-- compare what was actually the case to what various theories would have predicted.

The most important macroeconomic data are, of course, the six key variables set out chapter one:

- Real GDP (Gross Domestic Product)
- The unemployment rate
- The inflation rate (that is, the proportional rate of change in the price level)

- The interest rate
- The level of the stock market
- The exchange rate.

Learn these six measurements of the economy--what their current values are, what their trends have been over time, what their future values are projected to be, how they are calculated, and what they mean--and you will have an excellent knowledge of the state of the economy. Table 2.1 summarizes the major features of the six key economic variables

Table 2.1: The Six Key Economic Variables

Variable	Details	Importance
Real GDP	Rough synonyms include GNP, NNP, NDP, "national income," "aggregate demand," and "total production"	The principal measure of material well-being and economic productivity.
Unemployment Rate	As reported, omits "discouraged workers" who would like to work but have stopped looking for jobs.	The principal measure of how far production is falling short of potential output; a measure of the relative distribution of economic well-being.
Inflation Rate	Most economists think officially-reported statistics overstate the true increase in the nominal cost of living by 0.5 to 1.0 percent per year.	The proportional rate of change of the price level. Central banks today view their principal mission as assuring price stability--keeping the rate of inflation low enough that nobody worries about it much.
Interest Rate	The most important interest rates are "real"--those that control for the effects of inflation--and long term.	The real long-term interest rate is the principal determinant of the level of investment, and a principal determinant of future production growth
Stock Market	A broad index like the S&P is better than a narrow index like the Dow-Jones.	The stock market summarizes into one single index a large number of influences on investment, including investors' optimism, expected future profits, and the real interest rate.
Exchange Rate	Once again, the most important rate is the real rate.	The exchange rate determines the relative price of foreign-made goods in terms of home-produced goods. Economists usually work with an index of the value of the dollar against an average of all other currencies, and call

		that "the" exchange rate.

Let's see how they are calculated, but in reverse order--starting with the exchange rate and ending with real GDP.

2.2 The Exchange Rate

Nominal Versus Real Exchange Rates

The nominal exchange rate is the relative price of two different kinds of money, as set in the *foreign exchange market.* Domestic exporters earn foreign currency when they export--sell goods to people abroad. Foreign producers earn domestic currency when they sell us imports--sell their goods to people here. Both then have a problem. Domestic exporters can't pay domestic workers with foreign currency. Foreign producers can't pay foreign workers with domestic currency. Foreign producers need to trade the dollars they have earned for money that is useful to them. Domestic producers need to trade the foreign currency they have earned for dollars they can use.

How do foreign producers and domestic exporters solve this problem? They turn to the foreign exchange market, where those who have foreign currency but want dollars exchange it for dollars, and those who have dollars but want foreign currency exchange dollars for other currencies. Those with foreign currency who want dollars include not only domestic exporters but also includes foreigners wishing to invest in the United

States. Those with dollars who want foreign currency include not only foreigners who have sold Americans imports but also American residents who wish to investabroad.

If the *nominal* exchange rate between the dollar (the currency of the United States) and the euro (the currency of the European Union) is $1.20 = €1.00, then a single euro costs $1.20 in U.S. currency. It takes less than one euro--0.83 euros and change--to buy a single dollar.

Figure 2.1: The Market for Foreign Exchange

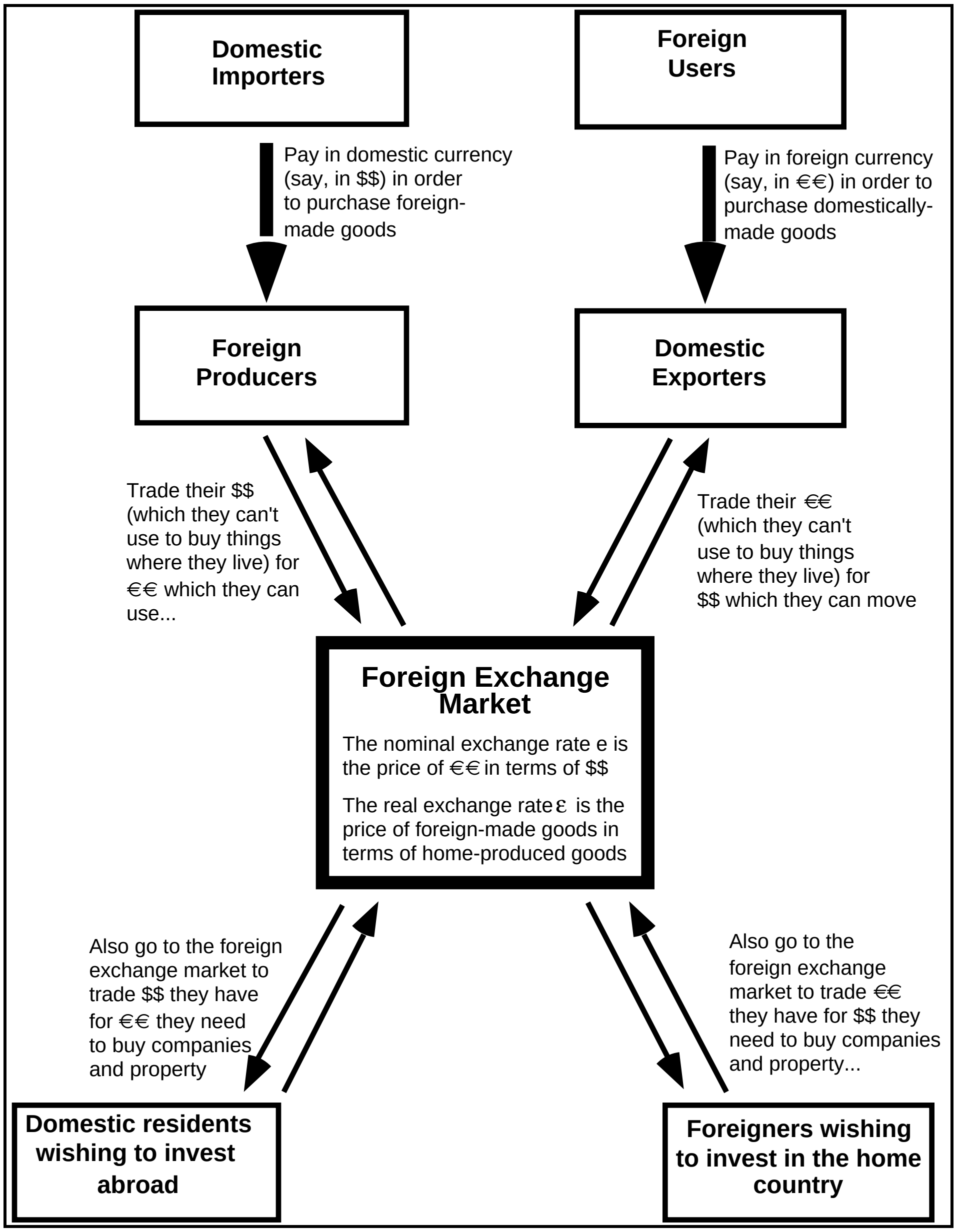


Figure Legend: In the foreign exchange market, domestic exporters and foreigners wishing to travel or invest trade their foreign currency for domestic

> currency. Conversely, those who wish foreign currency trade domestic currency for it.

Economists, however, are more interested in the *real* exchange rate: the nominal rate adjusted for changes in the value of the currency. The nominal—the money—exchange rate can change without affecting the pattern of cross-national trade. When the real exchange rate—the rate in terms of goods and services—changes, the pattern of cross-national trade must change as well.

Suppose a burst of inflation were to double the price level in the United States, so that everything that once cost $1 in the U.S. now costs $2, everything that used to cost $2 now costs $4, and so on. Suppose also that the nominal exchange rate were to change from $1.20 = €1.00 to $2.40 = €1.00. Before the burst of inflation you could sell goods in Europe for €0.83 (and change), turn the euros into $1.00, and buy American goods. After the burst of inflation you could sell goods in Europe for €0.83 (and change), turn the euros into $2.00, and buy… the exact same American goods as before. The change in the nominal exchange rate has offset the change in the U.S. price level. In this case the real exchange rate--the rate at which goods trade for goods—has not changed. The terms at which the goods of one country are traded for the goods of another are the same.

Now suppose that a burst of inflation were to double the price level in the United States, but that $1.20 still exchanges for €1.00 on the foreign exchange market. Has the exchange rate changed? The nominal exchange rate has not changed: 0.83 (plus change) euros will still get you a paper dollar; $1.20 will still get you a euro. However, that paper dollar will buy only as many goods in the United States as 50 cents would have bought before. The doubling of the U.S. price level, coupled with the unchanged nominal exchange rate, means that the same quantity of U.S.-made goods will buy twice as many European-made goods. Thus the real exchange rate has halved.

Of course, if the price levels in different countries do not change, then there is no distinction between a change in the nominal exchange rate and a change in the real exchange rate. If the nominal exchange rate were to double-- to change from $1.20 = €1.00 to $2.40 = €1.00—but the price levels in the United States and Europe remained the same, then investors would need twice as many dollars to buy the same amount of foreign currency. Thus it would cost twice as many U.S.-made goods to buy the same amount of foreign-made goods. The real exchange rate would have doubled.

The Real Exchange Rate

Calculating the Real Exchange Rate

To calculate the real exchange rate ε you need to know three pieces of information. First, you need to know the price level in the home country--call it P, for **P**rice. Second, you need to know the price level abroad-- call it by P*. (It is conventional in macroeconomics to let *s stand for values abroad in foreign countries.) Third, you need to know the nominal exchange rate--call it e, for **e**xchange. You can then calculate the value of the real exchange rate by multiplying the nominal exchange rate by the ratio of the home price level to the foreign price level:

$$\varepsilon = e \times \frac{P}{P*}$$

Box 2.1 illustrates how the process works.

Box 2.1-- Calculating the Real Exchange Rate: An Example

Suppose that the index of the U.S. price level were 120, the index of the foreign--the euro--price level were 83.333, and the nominal exchange rate--the price of the foreign currency in dollars--were $1.20 = €1. Then the real exchange rate would be:

$$\varepsilon = e \times \frac{P}{P*} = 1.2 \times \frac{120}{83.333} = 1.2 \times 1.44 = 1.73$$

Now suppose the U.S. price level were to rise to 150, the foreign price level were to rise to 100, and the price of foreign currency were to fall to parity--$1.00=€1. In that case the real exchange rate would be:

$$\varepsilon = e \times \frac{P}{P*} = 1.0 \times \frac{150}{100} = 1.0 \times 1.5 = 1.5$$

That is all there is to calculating real exchange rates.

Calculating the OverallExchange Rate: Index Numbers

If you open up a newspaper in search of *the* exchange rate for the dollar, you will not find it. Instead you will find a list of rates like the one in Table 2.2 only with many more entries--one line for almost every country on the globe:

Table 2.2: Sample Exchange Rates

Currency	Value	Change	High	Low
Australian dollar *	0.6465	-0.0002	0.6467	0.6467
British pound *	1.60200	-.00210	1.60410	1.60250
Canadian dollar	1.49000	-.00010	1.49170	1.49100
The euro *	1.06080	0.00000	1.06100	1.06080
French franc	6.1783	0.0000	6.1783	6.1783
German mark	1.8425	0.0000	1.8425	1.8421
Italian lira	1824.00	0.00	1824.00	1824.00
Japanese yen	109.85	-0.15	110.01	109.90
New Zealand dr *	0.5180	-0.0007	0.5186	0.5186
Swiss franc	1.5065	+0.0002	1.5065	1.5060

* means U.S. dollars per currency unit; otherwise currency units per U.S. dollar.

There is an exchange rate for the dollar against each and every other currency--a dollar-Swiss franc exchange rate, a dollar-yen exchange rate, a dollar-euro exchange rate, a dollar-pound exchange rate, a dollar-Canadian dollar exchange rate, a dollar-Mexican peso exchange rate, and more than one hundred more for all the other currencies. Which of these is "the" exchange rate?

In this situation economists do what they usually do when they are confronted with too much variety. They take an average, and hope that deviations from the average will cancel each other out. In other words, they construct an *index number* to stand in place of the more than one hundred exchange rates of the U.S. dollar against other currencies. The usual approach is to take a trade-weighted average, in which each currency receives a weight equal to its share of total U.S. trade.

Let's go through the steps of calculating an index number for the exchange rate. To keep this example simple, we will restrict ourselves to the U.S. exchange rate vis-à-vis the six largest other industrial countries.

First, we set the *base year* to be 1992, meaning that all exchange rates that we average will be relative to their value in 1992. They will all be of the form:

$$\frac{Exchange\ \ rate\ \ in\ \ this\ \ year}{Exchange\ \ rate\ \ in\ \ 1992}$$

Furthermore, each exchange rate's weight in the index will be the share of U.S. trade with that particular country's economy in 1992. Thus the index number can be represented by the equation:

$$\text{Index} = \sum_{all\ \ countries} \left\{ \frac{(Exchange\ \ rate\ \ in\ \ this\ \ year)}{(Exchange\ \ rate\ \ in\ \ 1992)} \times (Share\ \ of\ \ trade\ \ in\ \ 1992) \right\}$$

where the "Σ"--the Greek capital letter sigma--stands for "sum" or "add up," the brackets to the right of the sigma tell what is to be summed, and the notation just underneath the sigma tells the range over which the sum applies. The equation says "For all of these countries, add up the products of their exchange rates this year divided by their exchange rates in 1992 and their share of total trade with the United States in 1992."

By convention, economists usually set the value of an index number in its base year to 100. To do this, simply multiply the equation for the index by 100:

$$Index = 100 \times \sum_{all\ \ countries} \left\{ \frac{(Exchange\ \ rate\ \ in\ \ this\ \ year)}{(Exchange\ \ rate\ \ in\ \ 1992)} \times (Share\ \ of\ \ trade\ \ in\ \ 1992) \right\}$$

Table 2.3 shows the results of this calculation in the year 1995.

Table 2.3: Calculating the Exchange Rate Index for 1995

Country	Exchange Rate (Value of Foreig Currency) in 199:	Exchange Rate (Value of Foreig Currency) in 199!	Exchange Rate i 1995/Exchange Rate in 1992	Share of 1992 Trade		Contribution to Index
Canada	0.781	0.729	0.933	0.332		0.310
Japan	0.008	0.011	1.349	0.249		0.337
Britain	1.766	1.579	0.894	0.124		0.111
France	0.189	0.201	1.062	0.097		0.103
Germany	0.640	0.698	1.091	0.111		0.121
Italy	0.001	0.001	0.756	0.086		0.065
					Sum:	1.047
					x 100 =	
					Value of Index	**104.674**

Figure 2.2: The Exchange Rate Index in the 1990s

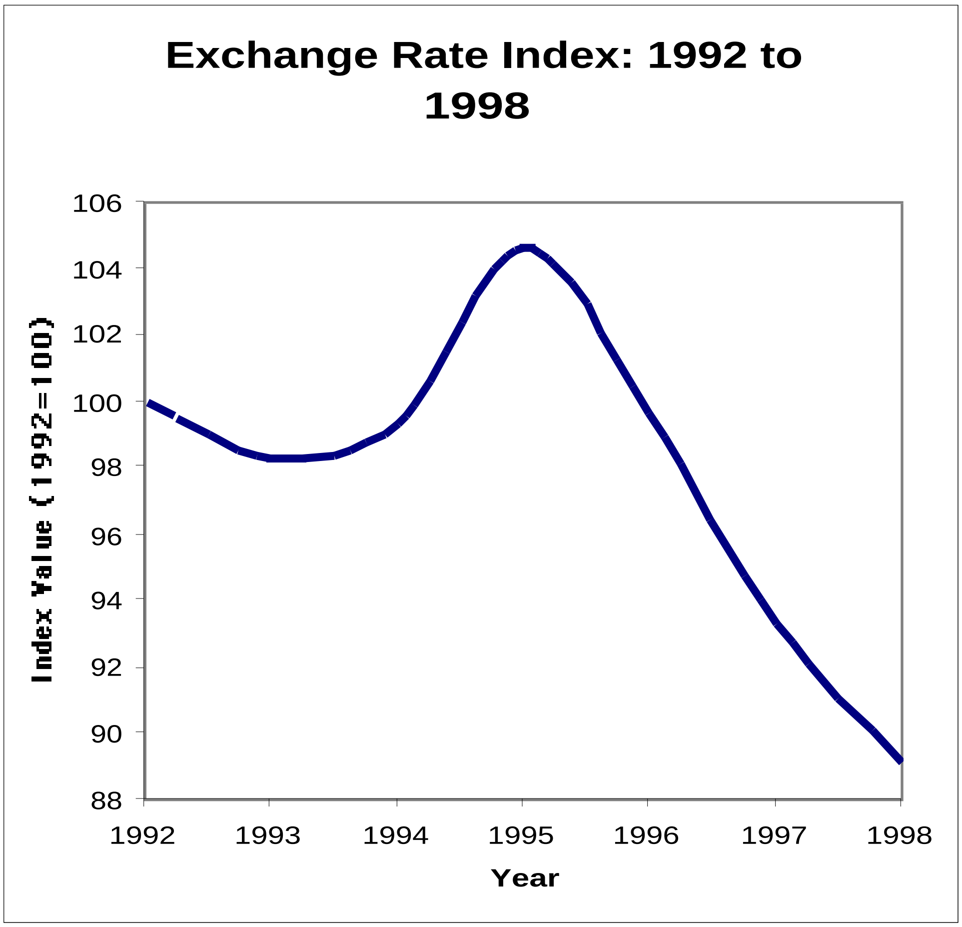


Figure Legend: In 1998 the real exchange rate for the U.S. dollar was some eleven percent below its level in 1992. In 1998 a given amount of foreign-made goods could be used to purchase only 89 percent as many U.S.-made goods as it could have purchased in 1992.

Source: Author's calculations from data provided in the 1999 edition of *The Economic Report of the President* (Washington, DC: Government

Printing Office).

We have gone step by step through the process of defining the exchange rate, distinguishing between real and nominal exchange rates, calculating real exchange rates, and calculating a weighted average to arrive at "the" exchange rate. Both the calculation of index numbers and the distinction between real and nominal quantities will come up over and over again in this book. That is why we have devoted so much space here to these topics.

2.3 The Stock Market and Interest Rates

The Stock Market

We don't have to calculate the value of an index for the stock market because news agencies perform that task for the public already. The best--the most representative--index of the U.S. stock market is probably Standard and Poor's Composite Index, usually called the S&P 500. The index you will hear about most, however, is the Dow-Jones Industrial Average. But if the DJIA tells a different story from the S&P, ignore it: it is less representative of the market than the S&P.

Though we don't have to assemble and calculate a stock market index, we do have to divide the numbers reported in the news by some measure of the price level--usually either the *GDP deflator* or the *Consumer Price Index* [CPI]. If both the price level and the (nominal) value of the stock market double, a representative share of stock is worth no more in real terms. To arrive at real magnitudes, economists *deflate* nominal magnitudes like a stock index by some measure of the price level in order to arrive at *real* magnitudes. In this case we are most interestd in the real value of the stock market.

The Usefulness of Knowledge About the Stock Market?

Current stock market indexes are the easiest economic statistics to get. But what good is knowing the real value of the stock market to a macroeconomist? The stock market is a sensitive indicator of the relative optimism or pessimism of investors, and therefore a good forecaster of future investment spending.

To see why, we need to think about the mechanisms underlying the stock market. Most investors in the stock market face a choice between holding stocks and holding bonds. Stocks are shares of ownership of a corporation, and give you ownership of that corporation's profits or earnings. Bonds are debts that the corporation owes you. A bond is a piece of paper that gives you periodic interest payments and, at the bond's maturity, returns you the principal amount of the bond.

It is clear what the rate of return is on money invested in bonds. It is simply the interest payment the bond issuer makes divided by the price of the bond. Call this real rate of interest in the economy r. If you invest in shares of stock, what is your rate of return? You paid a price P^s ("P" for price, "s" for stock) for each share. The corporation reports earnings E^s per share. Some of those earnings will be paid out directly to shareholders in the form of dividends. Others will be retained and reinvested, boosting the corporation's fundamental value. Both components increase shareholder wealth, and together they are the return on the investment in stocks. Thus an investor in stocks gets a return on each dollar invested of:

$$\frac{E^s}{P^s}$$

Which will the investor prefer to hold, stocks or bonds?

Saying that investors will prefer stocks if E^s/P^s is greater than r is not quite right. Investments in stocks are risky. The company might go bankrupt, its reported earnings might be rigged, or the market might go down. As compensation for this risk, investors in stocks demand an extra return called the *risk premium*, or σ^s (the Greek lower-case letter sigma with an "s" for stocks as a superscript). So investors will want to hold only stocks if:

$$\frac{E^s}{P^s} > r + \sigma^s$$

Investors will want to hold safer bonds if:

$$\frac{E^s}{P^s} < r + \sigma^s$$

And investors will hold both stocks and bonds if:

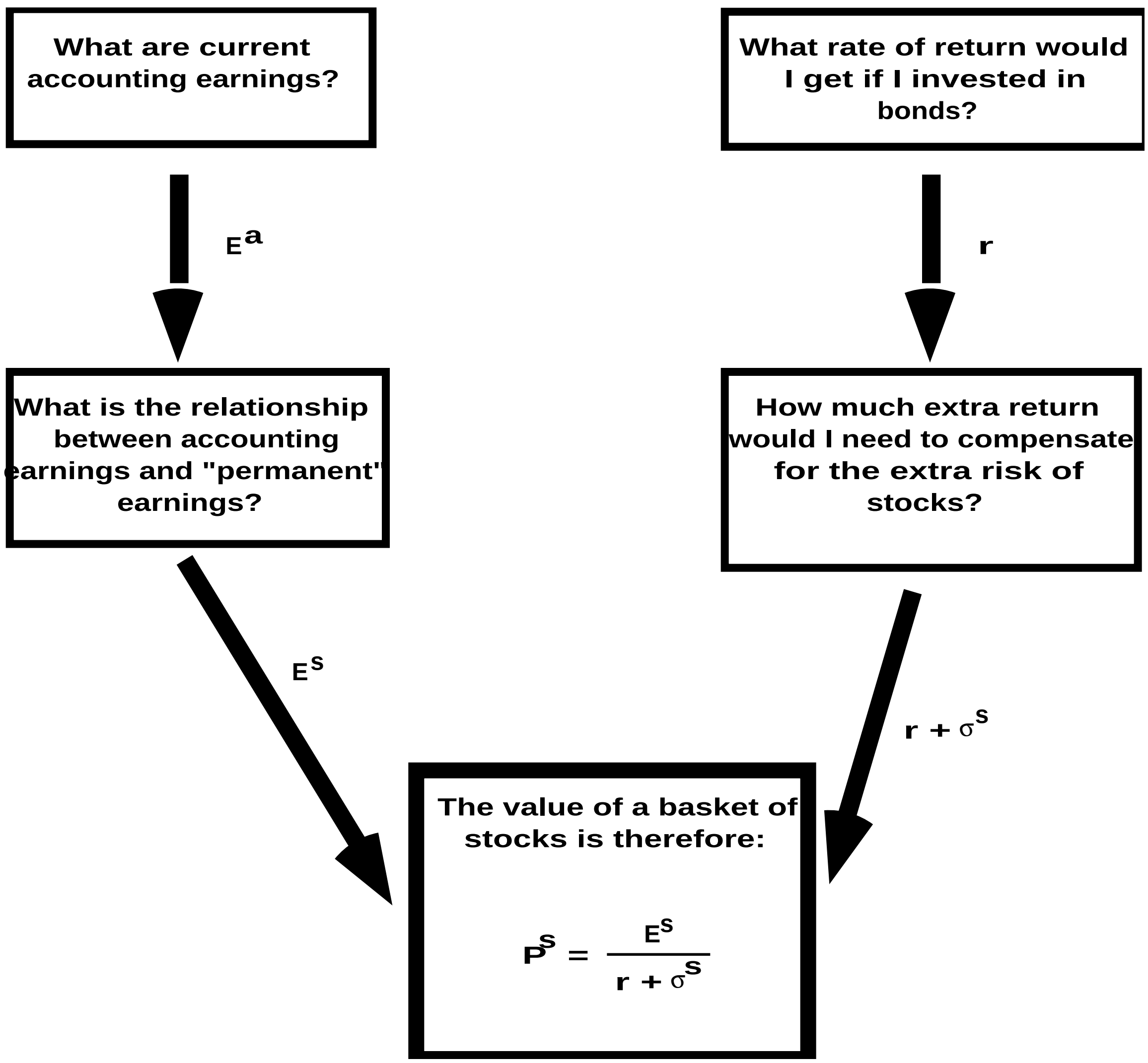
$$\frac{E^s}{P^s} = r + \sigma^s$$

Since in the world outside the classroom we do see investors holding *both* stocks and bonds—some holding one, some holding the other, and some holding both—it is this last equation that must be true. If we turn this equation around, the value of stocks is equal to corporate earnings divided by the sum of the real interest rate on bonds and the risk premium:

$$P^s = \frac{E^s}{r + \sigma^s}$$

However, there is one more complication. The accounting earnings reported in the financial press--call them E^a--are not the earnings E^p that belong in the numerator of the stock valuation equation. The financial press reports what the firm's accountants have calculated, but investors are interested in some long-run average of expected future earnings. In order to apply the stock-price valuation formula, you also need an estimate of the relationship between the current earnings E^a that you read in the newspaper and "permanent" earnings E^s.

Figure 2.3: Calculating the Value of a Basket of Stocks



The Stock Market Summarizes a Lot of Information

Thus the real value of the stock market sums up--in one number that is reported every day:

- The current level of earnings, or profits.

- Whether investors are optimistic (expecting long-run earnings to be above today's level) or pessimistic (expecting long-run earnings to be below today's level), and how optimistic or pessimistic they are.
- The current cost of capital--whether money is cheap and easy to borrow (in which case r is low) or expensive (in which case r is high).
- Attitudes toward risk: whether people are strongly averse to the risks involved in entrepreneurship (in which case σ^s is high) or willing to gamble on new industries and new businesses (in which case σ^s is low).

These are the factors that determine whether corporate managers' are willing to undertake investments to boost their companies' capital stocks. Thus the stock market summarizes all the information relevant to the economy-wide level of investment spending. It's usefulness as a summary of all the information relevant to determining investment spending is the reason it is one of the six key variables of macroeconomics.

Interest Rates

The interest rate is the price at which purchasing power can be shifted from the future into the present--borrowed today with a promise to pay it back with interest in the future. Interest is not a single lump sum, but an ongoing stream of payments made over time. Thus it is what economists call a *flow* variable. A flow variable cannot be measured simply as a quantity: it must be measured as a quantity per unit of time. In the case of the interest rate, it is measured not as a percentage of the amount borrowed, the principal, but as a *percentage per year*.

Economists like to talk about "the" interest rate in the same way that they like to talk about "the" exchange rate. But just as there are a large number of different exchange rates, there are a large number of interest rates. Loans of higher risk carry higher interest rates: whoever you lent your money to might not pay it back--that is a risk you accepted when you lent in the first place. Loans of different duration carry different interest rates as well. Moreover, differences in tax treatment--whether and when you have to pay taxes on interest earned from bonds--also lead to differences in interest rates..

Thus even with respect to U.S. government bonds--the ultimate in safe investments--there is no single interest rate. Table 2.4 shows a small sample of the interest rates quoted on U.S. Treasury securities with maturities between a few months and 30 years. Note that the price quoted depends on whether you are buying or selling: market makers need their margin. For instance, you can buy a 30-year Treasury bond that pays annual interest of $5.375 for every $100 of initial "face value" at a price of 99 and and 7/32 dollars--$99.21875--for each $100 of face value. But if you want to sell that same bond you could get only 99 and 5/32 dollars--$99.15625.

Table 2.4: Treasury Yield Curve

On-The-Run U.S. Treasury Curve 02/14/01 09:00 Pacific

Term	Coupon	Maturity	Years	Bid	Ask	Chg	Yield
3mo	-	05/17/01	0.25	4.92	/ 90	+.01	5.071
6mo	-	08/16/01	0.50	4.80	/ 78	+.04	5.007
1yr	-	11/29/01	0.79	4.61	/ 59	+.04	4.824

2yr	4 3/4	01/31/03	1.96	99-29	/ 31	-03	4.785
5yr	5 3/4	11/15/05	4.75	103-14	/ 16	-07	4.927
10yr	5	02/15/11	10.00	99-09	/ 11	-04	5.093
30yr	5 3/8	02/15/31	30.00	99-05	/ 07	-06	5.432

Source: CBS Marketwatch
http://cbs.marketwatch.com/data/newsroom/mwb_tres.htx?source=htx/http2_mw

Moreover, the interest rates published in the newspaper are nominal rates: they tell how much money you earn in interest per year if you lend out a sum of dollars now and collect the principal at the loan's maturity. You will not be surprised to learn that economists are interested instead in the real interest rate: how much purchasing power over goods and services you get in the future in return for trading away your purchasing power over goods and services today.

When we calculate real exchange rates, or real stock values, or real GDP, we divide the nominal exchange rate or stock index value or nominal GDP level by the price level, but that is not what we do to calculate real interest rates. Instead of dividing the nominal interest rate by the price level, we *subtract* the inflation rate--the percentage rate of change in the price level--from the nominal interest rate to get the real interest rate. Box 2.2 explains the reason for this procedure.

Box 2.2-- Calculating Real Interest Rates: An Example

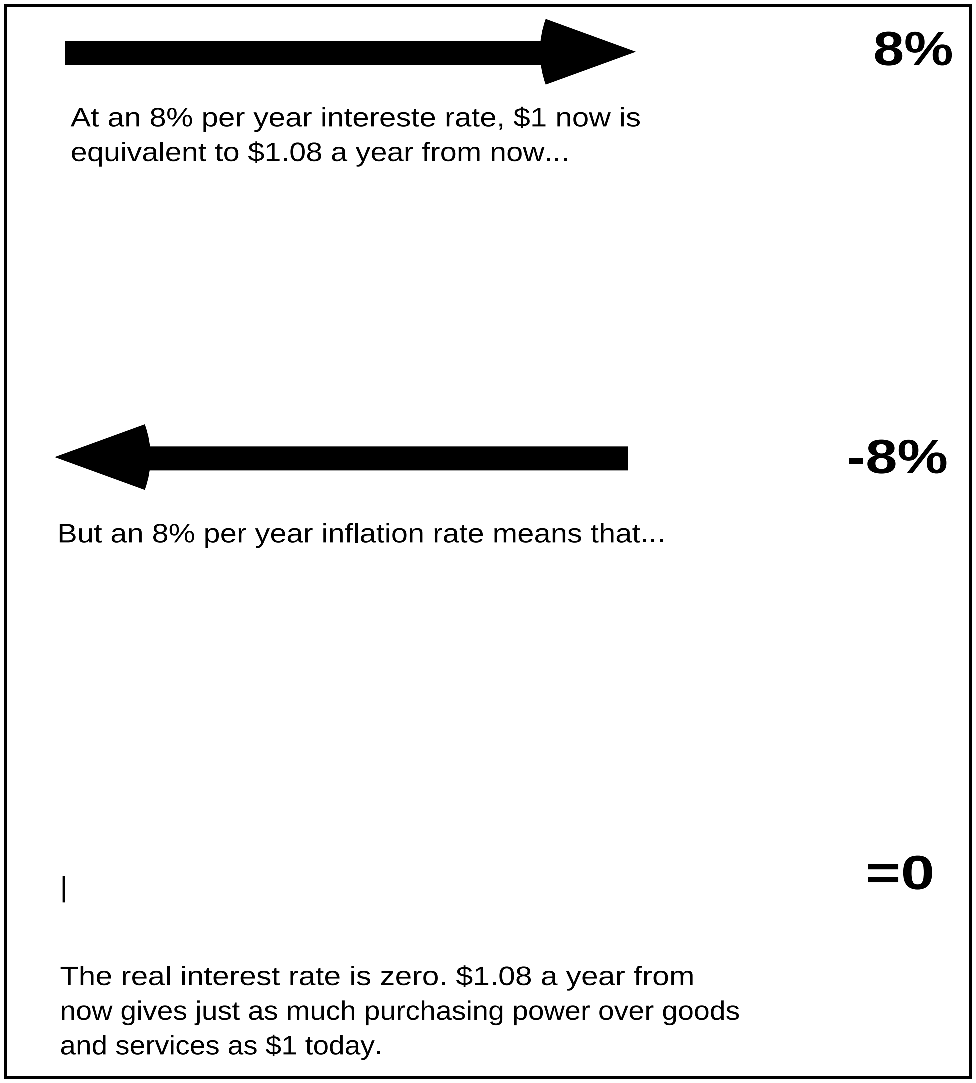
Why subtract the inflation rate from the nominal interest rate? Suppose you borrow $10 million for one year at a nominal interest rate of 8% per year. Suppose further that the annual inflation rate is 8% also, so that the price level will rise by 8% between now and next year. Thus whatever goods you want to buy (let's say you want to buy cheap television sets) at a price of $200 a set this year will cost $216 a set by next year.

Right now when you borrow you get $10 million. Next year you have to pay back $10.8 million--$10 million principal and $800 thousand interest. You borrow enough now to buy 50,000 TV sets. Next year, when you pay back your loan with interest, you will pay the lender $10.8 million, just enough money to buy 50,000 cheap TV sets. Thus you will return the same purchasing power over goods and services you borrowed, making a real interest rate of zero (see Figure 2.4).

Suppose the inflation rate had been 4%, so that the price of a standard basket of goods and services--and of the cheap TV sets you are buying--will rise from $200 to $208 next year. You borrow $10 million, enough to buy 50,000 cheap TV sets. Next year, when you pay back your loan with its 8 percent annual interest, you will pay the lender $10.8 million, enough money to buy 51,923 TV sets. The extra 1,923 TV sets are a 3.846% increase in purchasing power over goods and services. Thus you will return 3.846% more purchasing power than you borrowed. However, to keep things the calculation simple economists just round it off, and call it a 4% real interest rate. (You will find that economists often round off numbers, drop small terms from equations, and generally do whatever they can to make things simpler.)

Thus the rule: to calculate a *real* interest rate, subtract the inflation rate from the *nominal* interest rate.

Figure 2.4: The Real Versus the Nominal Interest Rate



Box 2.3--Useful Mathematical Tools

In saying that the real interest rate is the nominal interest rate minus the inflation rate we are using one of three mathematical tools that will make life a lot easier throughout this book. They are all *approximations*. But they are all close enough for our purposes, and they make life simpler.

They are:

(1) The growth-of-a-product rule: *The proportional change of a* product *is equal to the* sum *of the proportional changes of its components.*

(2) The growth-of-a-quotient rule: *The proportional change of a* quotient *is equal to the* difference *between the proportional changes of its components.*

(3) The growth-of-a-power rule: *The proportional changes of a quantity raised to a power is equal to the proportional change in the quantity, times the power to which it is raised.*

As we just saw in calculating the real interest rate, these three rules are only approximations: an 8% increase in a nominal sum of money and a 4% increase in the price level produces not a 4% but a 3.846% increase in real purchasing power over goods and services. But they *are* close enough.

To illustrate the first, product, rule (1), suppose we have two variables, P (price) and Q (quantity), that together are multiplied to make up E (expenditure), E = P x Q. Then the:

$$(\text{Proportional Change in } E) = (\text{Proportional Change in } P) + (\text{Proportional Change in } Q)$$

Thus if real production Q is growing at 5% per year, and the price level P is growing at 2% per year, then total nominal expenditure E will be growing at a proportional rate of 5% + 2% = 7% per year.

To illustrate the second, quotient, rule (2), start out with E (expenditure) and Q (quantity) so that when we divide them we get P (price), E/Q = P. Then the:

$$(\text{Proportional Change in } P) = (\text{Proportional Change in } E) - (\text{Proportional Change in } Q)$$

Thus, if nominal expenditure E is growing at 7% per year, and real production Q is growing at 5% per year, then the price level P must be growing at a proportional rate of 7% - 5% = 2% per year.

To illustrate the third, power, rule (3), suppose that real GDP Y is equal to the economy's capital stock K raised to a power--K^{α}, K raised to the power α (Recall that $X^{0.5}$ is the square-root of X, that $X^1=X$, and that $X^2 = X \times X$). Then the:

$$(\text{Proportional Change in } Y) = \alpha \times (\text{Proportional Change in } K)$$

Thus, if α equals 0.5, so that $Y = K^{0.5}$, then if the capital stock K is growing at 6% per year, real GDP Y will be growing at 0.5 x 6% = 3% per year.

You may hear people say that a background in calculus is needed to understand intermediate macroeconomics. That is not true. 95% of what calculus is used for in intermediate macroeconomics is contained in these three mathematical tools. (Of course, calculus is needed if you want to understand just why they work.)

2.4 The Price Level and Inflation

The Consumer Price Index

Already the idea that economists need to measure the price level and to use it to calculate real quantities has come up several times. Estimating the price level and its proportional rate of change--the inflation rate--is at the heart of macroeconomics.

The most frequently seen measure of the overall price level is the Consumer Price Index, or CPI. (Other measures of prices include, to name three, the Producer Price Index of prices paid not by consumers but by companies, the economy-wide GDP deflator, and the Domestic Purchases deflator.) The CPI is calculated and reported once a month by the Bureau of Labor Statistics. The CPI is an expenditure-weighted index, in which each good or service receives a weight equal to its share in total expenditure in the base year.

Box 2.4-- Calculating Price Indices: An Example

One standard example economists use to illustrate how a price index is calculated is an index for consumers of fruit (perhaps because building indexes allows economists to really add apples and oranges). Suppose that in the base year a consumer buys $4.50 worth of oranges, at a price of $0.75 a pound; $4.20 worth of apples, at a price of $1.20 a pound; $0.90 worth of pears, at a price of $0.90 a pound; and $0.40 worth of bananas, at a price of $0.40 a pound.

Then, with a total of $10 spent on fruit in the base year, the price index for fruit will be given by:

$$\text{Price Index for Fruit} = \frac{\text{Price of Oranges Today}}{\text{Price of Oranges in Base Year}} \times (\text{Orange Index Weight}) + \frac{\text{Price of Apples Today}}{\text{Price of Apples in Base Year}} \times (\text{Apple Index Weight}) + \frac{\text{Price of Pears Today}}{\text{Price of Pears in Base Year}} \times (\text{Pear Index Weight}) + \frac{\text{Price of Bananas Today}}{\text{Price of Bananas in Base Year}} \times (\text{Banana Index Weight})$$

$$= \frac{\text{Price of Oranges Today}}{\$0.75} \times (45) + \frac{\text{Price of Apples Today}}{\$1.20} \times (42) + \frac{\text{Price of Pears Today}}{\$0.90} \times (09) + \frac{\text{Price of Bananas Today}}{\$0.40} \times (04)$$

We multiply the total annual expenditure on each fruit by 100 so that in the base year the price index will be equal to 100, as is customary for economists to do.

Now consider a year in which, as is shown in table 2.5, the price of oranges has risen to $1.50, the price of apples has fallen to $1.00, and the prices of pears and bananas have not changed. The overall fruit price index will be:

$$\text{Price Index for Fruit} = \frac{\$1.50}{\$0.75} \times (45) + \frac{\$1.00}{\$1.20} \times (42) +$$
$$\frac{\$0.90}{\$0.90} \times (09) + \frac{\$0.40}{\$0.40} \times (04)$$
$$= 138$$

Table 2.5: Calculating a Price Index for Fruit: An Example

Fruit	Base-Year Expenditure	Base-Year Price	Subsequent-Year Price
Oranges	$4.50	$0.75/lb	$1.50/lb
Apples	$4.20	$1.20/.lb	$1.00/lb
Pears	$0.90	$0.90/lb	$0.90/lb
Bananas	$0.40	$0.40/.lb	$0.40/lb

The Bureau of Labor Statistics changes the basket of goods and services used in constructing the CPI on a somewhat irregular basis. They update the basket every five years if they have the money in their budget to do so; if not, they update the basket every ten years. Statisticians try to keep the weighted "market basket" of goods and services used in calculating the index reasonably close to the goods and services consumers are currently buying. If it were not, the CPI would be of doubtful relevance. Who would care about the rate of change in the price of a statistical market basket that didn't represent what consumers were really buying?

Kinds of Index Numbers

Using relative expenditure levels in a fixed base year as the weights in a price index produces a kind of index that economists call a Laspeyres index. The CPI is such a Laspeyres price index. Another type of index, a Paasche index, is in a sense the opposite of a Laspeyres index. A Laspeyres index of production or consumption counts up the current dollar value of what is produced or consumed, and divides by what the value of what is produced or consumed would have been if all commodities had sold for their prices in the base year. The expenditure weights in a Paasche index are variable: if expenditures on a particular good rise this year so it is a large part of the current dollar value, then that good's weight in the price index will rise too. The second most-often seen indicator of the price level, the GDP deflator, is a Paasche index. Box 2.5 compares the pluses and minuses of these two kinds of price indexes.

Box 2.5--Laspeyres and Paasche Index Numbers: The Details

To see the difference between a Laspeyres and a Paasche index, return to our fruit example of the previous box. Suppose the prices of apples, pears, and bananas remain at their base-year levels, but surprise frosts destroy the orange crops in *both* Florida and California. The price of oranges skyrockets to $8.25 a pound (see Table 2.6), so no one buys any oranges--instead, consumers double their purchases of apples, pears, and bananas to 7 pounds of apples, 2 pounds of pears, and 2 pounds of bananas.

The CPI for fruit, a Laspeyres index, would then be:

$$Price\ \ Index\ \ \ for\ \ Fruit = \frac{\$8.25}{\$0.75} \times (45) + \frac{\$1.20}{\$1.20} \times (42) +$$

$$\frac{\$0.90}{\$0.90} \times (09) + \frac{\$0.40}{\$0.40} \times (04)$$

= 550

According to this index, the price of fruit is 5.5 times as high as in the base year.

The deflator for fruit, a Paasche index, deflator-for-fruit would be:

- Total nominal expenditure on fruit in the frost year: $11.00
- Cost of buying those pieces of fruit in the base year: $11.00
- Dividing the first number by the second, we discover that the price of fruit has not chagned from its base-year value,100.

Table 2.6: Two Different Kinds of Indexes: An Index Number Example

Fruit	Base-Year Expenditure	Base-Year Price	Subsequent-Year Price
Oranges	$4.50	$0.75/lb	$8.25/lb
Apples	$4.20	$1.20/.lb	$1.20/lb
Pears	$0.90	$0.90/lb	$0.90/lb
Bananas	$0.40	$0.40/.lb	$0.40/lb

In general, a Laspeyres index overstates price increases. In the real world, when some items become expensive consumers *substitute* and instead buy other items that remain cheap. But a Laspeyres index, because it is based on a fixed market basket of goods and services, does not take account of this substitution. Thus it suffers from what economists call *substitution bias,* and tends to overstate changes. A Paasche index, on the other hand, understates the increase in fruit prices. It calculates the difference between the price today of the *fruit you bought* and their price back in the base year. The Paasche index takes account of substitution. But it doesn't take account of the fact that the substituted items are less valued than the items they replace. The Paasche index reports, in the example of Box 2.5, that the skyrocketing price of oranges has no effect on fruit prices: it makes no sense to say that a frost that makes oranges completely unaffordable has no effect on the price of fruit.

So which is the "correct" price index? The answer is that there is none. There is no final and definitive resolution to this "index number problem." All price indices are imperfect. All try to summarize in a single number what is inherently a multi-dimensional reality of many prices changing in different directions and different proportions.

To strike a balance between the two types of indexes and their two types of biases, the Commerce Department's Bureau of Economic Analysis and the Labor Department's Bureau of Labor Statistics have begun to move toward hybrid indices. To reduce substitution bias, the Bureau of Labor Statistics has begun using geometric averages--multiply two numbers together and take the square root--instead of arithmetic averages. And the Bureau of Economic Analysis has begun using a procedure called *chain weighting* to construct its indices.

With chain-weighting, each year's proportional change in the index is calculated using a different base year. For instance, the percentage change in the index from 1999 to 2000 is calculated using the average of 1999 and 2000 as the base; the change from 2000 to 2001 will be calculated using the average of 2000 and 2001 as the base; and the change from

2001 to 2002 will be calculated using the average of 2001 and 2002 as the base. The results of these calculations are then "chained" together to make up the index.

The Inflation Rate

The CPI is reported once a month in the form of the percentage change in consumer prices over the preceding month. "Consumer prices in November rose 0.3% above their level in October," a newscaster will say. Eventually, twelve monthly changes in consumer prices over the course of the year are added up and become that year's inflation rate. "The consumer price inflation rate in 1999 was 2.7 percent," the newscaster will say.

Because the inflation rate is a measure of the rate of change in prices over time, it is a *flow* variable. When we speak of the inflation rate, we speak of it as such-and-such percent *per year*. To speak of the inflation rate without reference to a measure of time is incomplete. But people do, and we always assume that when the time measure is omitted the inflation percentage is an annual rate.

What the inflation rate is at any moment depends on which price level it is based on. The CPI-based inflation rate will not be exactly the same as the GDP-deflator-based inflation rate. Figure 2.5 plots four different measures of inflation in the United States: the GDP deflator, a CPI for all urban consumers (the CPI-U), a CPI using an experimental method of taking account of housing prices (the CPI-U-X1), and the CPI that omits the volatile prices of food and energy, which can cause severe transitory fluctuations in the overall index (the CPI-U ex F&E).

Figure 2.5: Different Measurements of Inflation in the U.S., 1960-2000

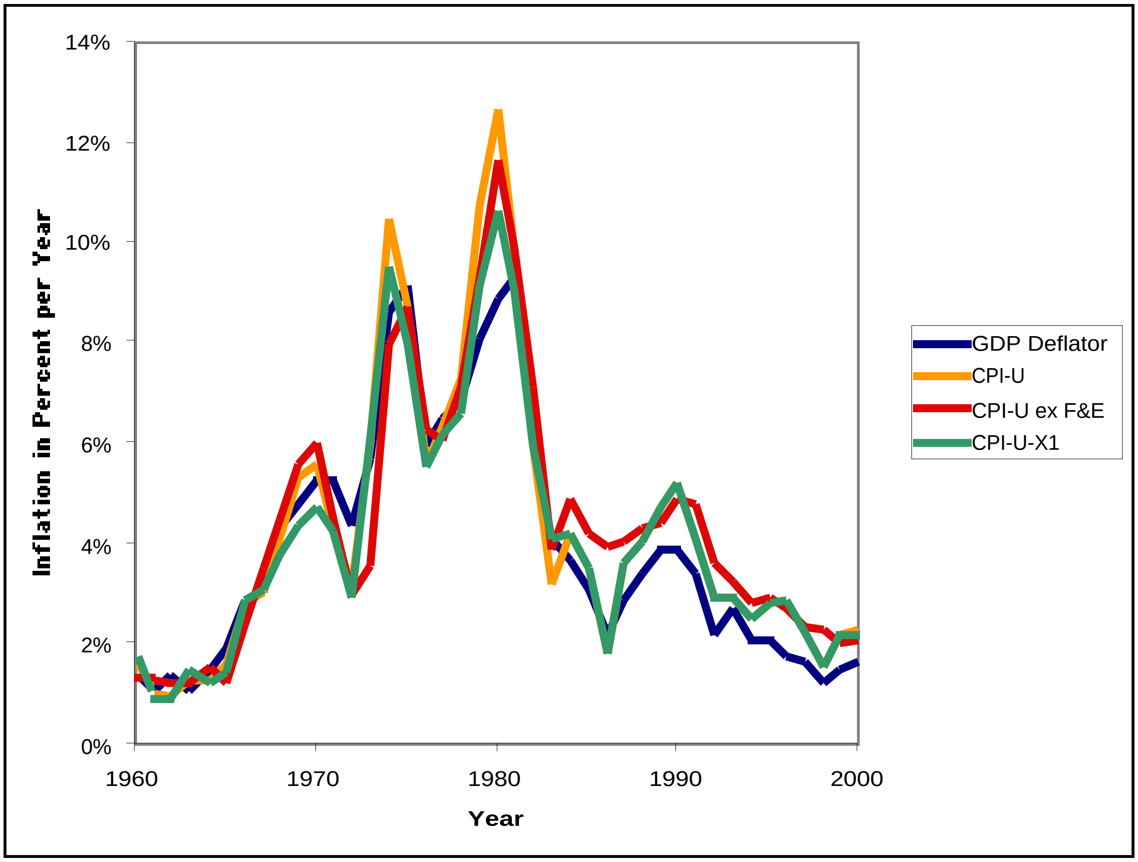


Figure Legend: Different measures of inflation tell slightly different stories about inflation. But all tell the same broad story: differences are small relative to the large swings in the inflation rate from one decade to another.

Source: Economic Report of the President, 2001 edition.

2.5 Unemployment

Calculating the Unemployment Rate

The unemployment rate is a key indicator of economic performance. An economy with persistent high unemployment is wasting its productive resources: its level of output is below its productive potential. Such an economy surely has a lower level of social welfare than might easily be attained. Being unemployed is not pleasant, not is fearing unemployment for no other reason than the turning of the wheel of the business cycle.

Keeping unemployment low is one of the chief goals of macroeconomic policy. Yet in the course of the business cycle unemployment rises and falls. Figure 2.6 shows the annual unemployment rate in the United States during the second half of the twentieth century. It shows the large variation in unemployment. Even though the second half of the twentieth century saw nothing like the extraordinary peaks of unemployment in the Great Depression, th eunemployment rate still varied from a low below four percent of the labor force to a high near ten percent of the labor force.

Every month the Labor Department's Bureau of Labor Statistics [BLS] sends interviewers to talk to 60,000 households in a nationwide survey called the Current Population Survey

[CPS]. The BLS uses this CPS to estimate the unemployment rate--the fraction of people who (a) wanted a job, (b) looked for a job, but (c) could not find an acceptable job.

Statisticians classify the people who are interviewed into four categories:

(1) Those who were employed in some sort of job when interviewed.

(2) Those who were out of the labor force and did not want a job immediately.

(3) Those who did want a job immediately, but had not been looking for one because they did not think they could find one.

(4) Those who did want a job immediately, had been looking, but had not found a job they would take.

Figure 2.6: The Unemployment Rate since 1950

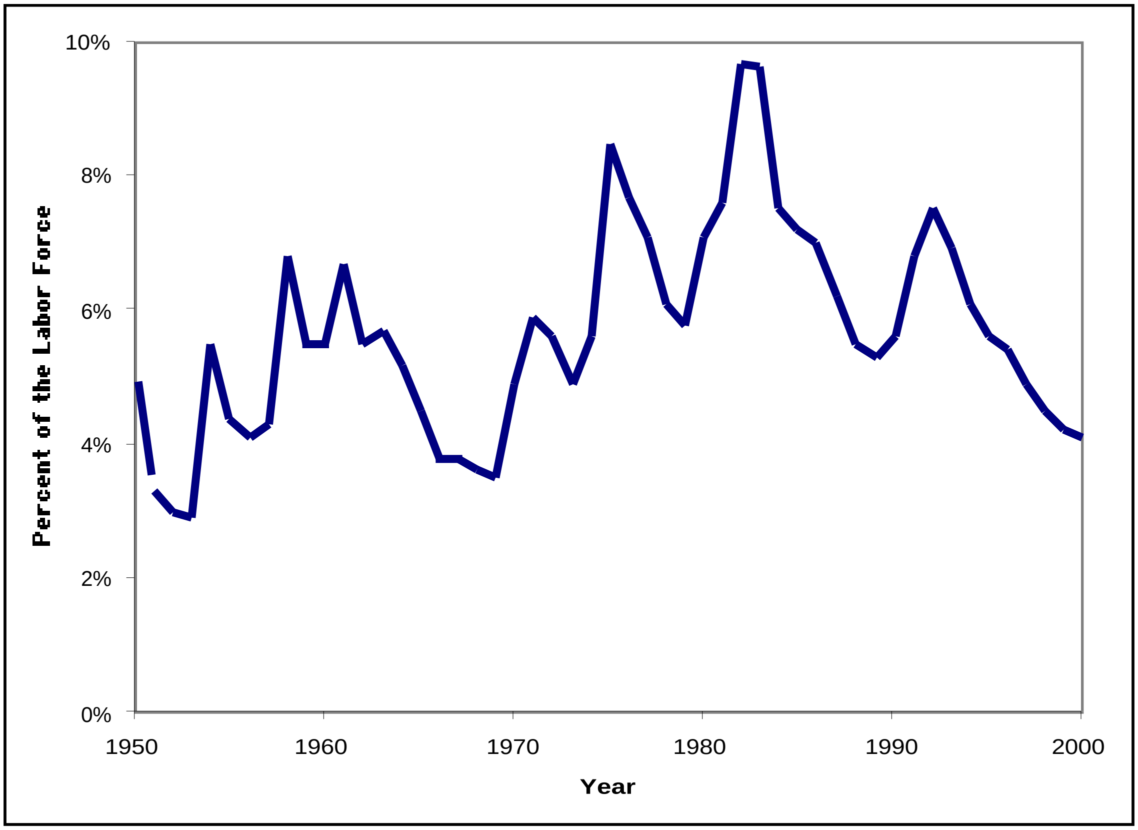


Figure Legend: On average, the unemployment rate was relatively low in the 1950s--about 4.5 percent. It then rose to an average of nearly 6 percent in the 1970s and 7 percent in the 1980s before falling back to near 4 percent in the second half of the 1990s. In addition to these slow decade to decade swings, we also see the ups and downs of the business cycle--the boom of the late 1960s, the deep recession of 1982-1983, and the smaller recession of 1990-1992, among others.

Source: 2001 edition of the *Economic Report of the President* (Washington, DC: Government Printing Office).

According to the BLS definition of the unemployment rate, the *labor force* is group (1) plus group (4): those who had jobs plus those who were looking for jobs:

$$Labor\ \ Force = (Employed) + (Looking\ \ \ for\ \ Work)$$

The unemployment rate is the numer of unemployed--those in group (4)--divided by the totallabor force:

$$Unemployment\ \ Rate = \frac{Looking\ \ \ for\ \ Work}{Labor\ \ Force} = \frac{Looking\ \ \ for\ \ Work}{(Employed) + (Looking\ \ \ for\ \ Work)}$$

In contrast to the inflation rate, which is a *flow* variable, the unemployment rate is a stock variable. Saying that the current unemployment rate is 4 percent, with no reference to a measure of time, makes perfect sense..

The official unemployment rate may well underestimate the real experience of unemployment. Someone in group (3), who wants a job but has given up looking, certainly feels unemployed, and may well feel as unemployed as someone in group (4). Perhaps these *discouraged workers* should be includedin the unemployment rate. Furthermore, some people in group (1) have part-time jobs but want full-time jobs. Perhaps these *part-time for economic reasons* should be counted as unemployed, or as half-unemployed.

Economists have noted striking and persistent variations in unemployment by demographic group and class. Teenagers age 16 to 19 have higher unemployment rates than adults, African-Americans have higher unemployment rates than whites, and high-school dropouts have higher unemployment rates than those who have post-graduate degrees. For most of the post-WWII period (but not recently) women have had higher unemployment rates than men. Significantly, recessions don't just raise the unemployment rate: they disproportionately raise the unemployment rate among these high-unemployment groups. Figure 2.7 contrasts the unemployment rates of various groups of workers.

Figure 2.7: U.S. Unemployment Rate by Demographic Group, 1960-2000

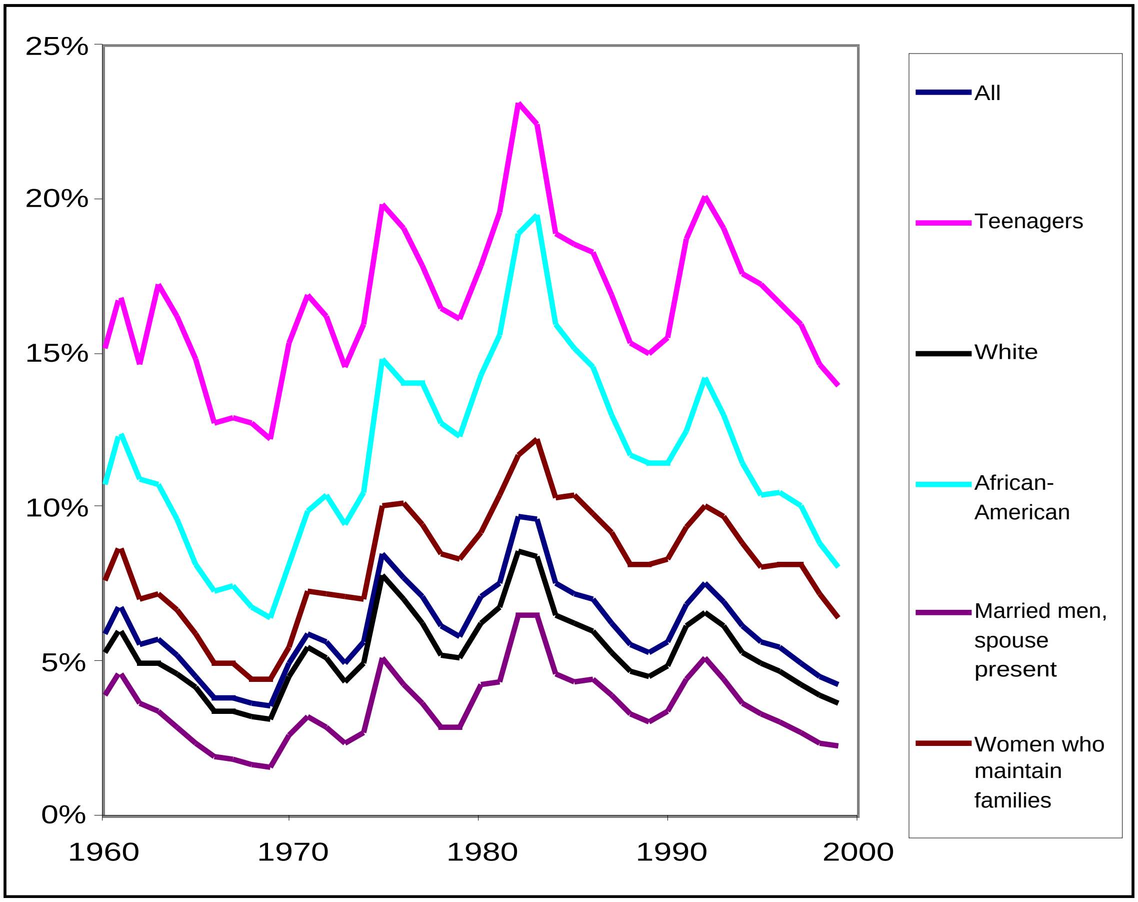


Figure Legend: The higher a group's average unemployment rate, the more the group's unemployment rate rises in recessions (and falls in booms). recessions—times of high and rising unemployment--are unusually difficult for teenager and African-American workers.

Source: 2001 edition of the *Economic Report of the President* (Washington, DC: Government Printing Office).

The question "how long is the typical person who loses his or her job unemployed?" is hard to answer because it is an ambiguous one. Most people who become unemployed on any one day--say, July 16, 2001-- remain unemployed for only a short time; more than half find a job within a month. Yet of all the people who are unemployed on July 16, 2001, some three-quarters of them will be unemployed for more than two months before they find another job.

Okun's Law

In the United States since World War II, the unemployment rate has been tightly coupled with the rate of growth of real GDP in a relationship called Okun's Law (see Figure 2.8). From any one year to the next, the very simple equation:

$$(Percentage\ Change\ in\ \mathrm{Re}al\ GDP) = (Percentage\ Growth\ in\ Potential\ Output) - 2.5 \times (Percentage - Po\mathrm{int}\ Change\ in\ Unemployment\ Rate)$$

fits the data very well. According to Okun's Law, unemployment falls (rises) when real GDP grows faster (slower) than potential output. Specifically, in the United States a one percentage-point fall in unemployment is associated with an extra two and a half percentage points of growth in real GDP. For example, in a year in which potential output grew 2.5 percent and unemployment fell by one percentage point, real GDP would grow by fully 5 percent.

Because of Okun's Law, if you know what is happening to real GDP relative to potential output, you have a good idea of what is happening to the unemployment rate--and vice versa. Box 2.6 explains the details of Okun's Law at greater length.

Figure 2.6: Okun's Law

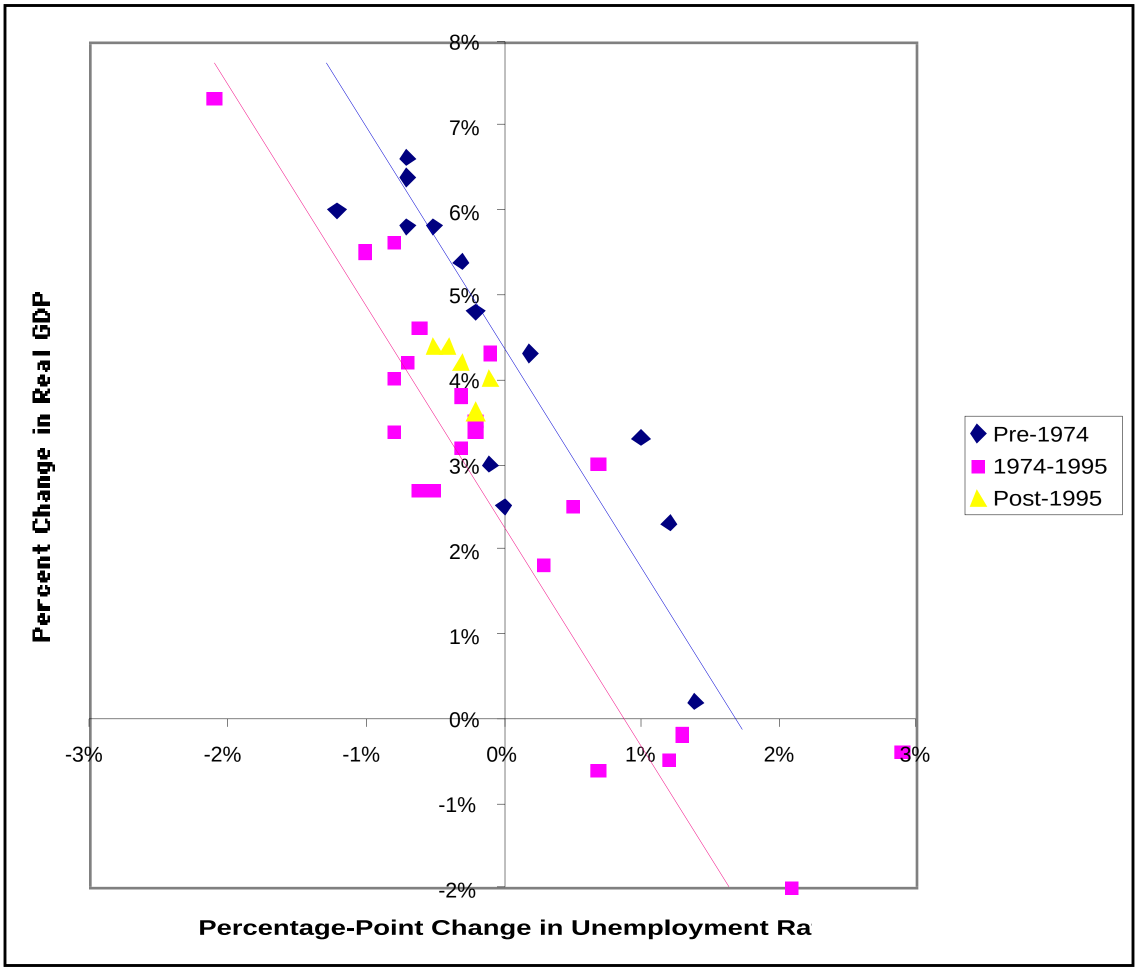


Figure Legend: An extra 2.5 percent of growth in a year's real GDP is associated with a one percentage point decline in the unemployment rate. Note that before 1974 the real GDP growth rate that kept unemployment constant was about 4 percent per year. Between 1974 and 1995, the unemployment rate was constant when real GDP growth was about 2.8 percent per year. Since 1995 there have been signs that the old pre-1974 relationship is reemerging.

We call the rate of growth at which unemployment rate is constant the rate of growth of potential output. The fall in the rate of growth of potential output after 1973—the so-called "productivity slowdown"—is one of the most important features of recent American economic history.

Source: 1999 edition of the *Economic Report of the President* (Washington, DC: Government Printing Office).

Box 2.6-- Why the Okun's Law Coefficient Is so Large?

Okun's Law posits not a 1-to-1 relation but a 2.5-to-1 relationship between real GDP growth and the unemployment rate. That is, a one percentage-point fall in the unemployment rate is associated not with a 1 but a 2.5 percent boost in the level of production.

Why is this Okun's Law coefficient so large? Why isn't it the case that a one percentage point fall in unemployment produces a one percent rise in output, or even less? One answer is that the unemployment rate, as officially measured, does not count discouraged workers. In a recession, the number of people at work falls, the number of people looking for work rises, and the number of people who are not looking for work because they doubt they could find jobs--but would be working if business conditions were better--rises. Because the conventionally-measured unemployment rate does not include these discouraged workers, more than a 1 percent rise in real GDP is needed to reduce the unemployment rate by 1 percentage point.

Moreover, when business returns to normal, firms' initial response is not to hire more employees, but to ask existing employees to work longer hours. So average hours of work per week go up, and the unemployment rate falls by less than one would otherwise expect.

Finally, in some industries employing more workers increases production by more than a proportional amount: product design and set-up need to be done only once, no matter how much is produced. Thus businesses which have *economies of scale* do not need twice as many workers to produce twice as much output.

2.6 Real GDP

Sixth and last of the key economic variables is real GDP, the most frequently used measure of economic performance. You will see other measures of total production and total income as well. All of them are close cousins of real GDP: GNP (Gross National Product), NNP (Net National Product), NDP (Net Domestic Product), and NI (National

Income). And you will hear commentators refer to "total output," "total production," "national product," "total income," and "national income." Except when you are focusing explicitly on the details of the National Income and Product Accounts [NIPA], treat all these terms as synonyms for real GDP.

Calculating Real GDP

Real GDP is calculated by adding up the value of all final goods and services produced in the economy. Because it measures the rate at which goods and services are produced, real GDP is a flow variable; it is usually expressed as an annual amount. Often, however, you will not hear the phrase "per year." But when you hear that real GDP in the fourth quarter of 2002 was such-and-such, remember such a statement means that the flow of production in the fourth quarter was such-and-such *per year*. And when you hear that real GDP in the fourth quarter of 2002 grew at so-and-so a percent, remember that such a statement means that real GDP in the fourth quarter grew at so-and-so a percent *per year*--the difference between real GDP in the third quarter and real GDP in the fourth quarter is only one-quarter of the reported annual growth rate.

What are the final goods and services that make up GDP? A final good or service is something that is not used further in production during the course of that year. Thus final goods and services include:

- Everything bought by consumers

- Everything bought by businesses not as an input for further production, but as an investment to increase the business's capital stock and expand its future production capacity
- Everything bought by the government.

Because GDP measures *product* and not *spending,* it includes a balancing item, exports minus imports. Because imported goods bought by consumers, installed as pieces of investment, or bought by the government were not made in the United States, they are not part of Gross Domestic *Product,* so imports need to be subtracted from GDP. Because exported goods bought by foreigners *were* made in the United States, they *are* part of GDP, and need to be added to the total.

Real and Nominal GDP

When economists add up final goods and services produced in the year to calculate GDP, how do they weight each good or service? The answer is that they use market value--what people paid for a good or service--in the calculation of *nominal* GDP. Box 2.7 presents a stylized, hypothetical example of how this is done.

Box 2.7--Example: Weighting Goods and Services by Their Market Values: An Example

How do economists weigh goods and services by their market values? Recall the discussion of the CPI earlier in this chapter (see page 000) in which the representative consumer bought 11.5 pounds of fruit:

Fruit	**Quantity**	**Price**
Oranges:	6 lbs	$0.75/lb
Apples:	3.5 lbs	$1.20/lb
Pears:	1 lb	$0.90/lb
Bananas:	1 lb	$0.40/lb

If these quantities were the final goods and services produced in a particular year--let's call it year 1--and we then wanted to measure the GDP of fruit, we simply multiply the quantities produced by their market prices:

$$
\begin{aligned}
GDP &= (6 \;\; lbs. \;\; oranges) \times (\$0.75/\,lb.) + (3.5 \;\; lbs. \;\; apples) \times (\$1.20\,/\,lb.) + \\
&\quad (1 \;\; lb. \;\; pears) \times (\$0.90\,/\,lb.) + (1 \;\; lb. \;\; bananas) \times (\$0.40\,/\,lb.) \\
&= \$10.00
\end{aligned}
$$

The nominal GDP of fruit in year 1 is $10.00.

In 2000 nominal GDP (that is, GDP measured at 2000 prices) was $9.99 trillion; in 1999 nominal GDP (that is, measured at 1999 prices) was $9.30 billion. Thus the growth rate of nominal GDP between 1999 and 2000 was 7.4 percent. But it is clear this *nominal* measure of GDP in which current-year prices are used to weight the final goods and services produced, and to calculate growth rates, is not a good measure of productivity or material output. It confuses changes in the overall price level--inflation or deflation--with changes in total production. Suppose production in the next year stayed unchanged but prices doubled; nominal GDP would double. Suppose the production doubled but prices stayed the same; nominal GDP would also double. While nominal GDP does not distinguish between these two sources of increase in total expenditure, we need to distinguish between them. Hence economists favor of real GDP--the value of final goods and services weighted by the prices of some particular base year. Box 2.8 illustrates the weighting of goods and services in temrs of base-year prices.

Whenever you hear a statement like "Real GDP in 1999 was $8.88 trillion 1996 dollars," remember that the "1996 dollars" means that 1996 is the base year of the calculation. When measured using 1996 prices, GDP in 1999--real GDP--was not $9.30 trillion but only $8.88 trillion. The difference--the gap between $9.30 and $8.88--was due to price inflation between 1996 and 1999. Real GDP between 1995 and 1996 rose by only 2.5 percent, not 4.5 percent.

Box 2.8--Weighing Goods and Services by Their Base-Year Values: An Example

Recall the hypothetical example of Box 2.7. Assume that in the year following year 1--year 2--the prices and quantities of fruit produced are as follows:

Fruit	Quantity	Price
Oranges:	8 lbs	$1.00/lb
Apples:	3.5 lbs	$1.20/lb
Pears:	1 lb	$0.50/lb
Bananas:	1 lb	$0.40/lb

Then we can calculate nominal GDP of fruit in both year 1 and year 2, and real GDP of fruit (at year 1 prices) in both year 1 and year 2:

•	Nominal GDP of fruit in year 1	= $10.00
•	Real GDP of fruit in year 1 (at year 1 prices)	= $10.00
•	Nominal GDP of fruit in year 2	= $13.10
•	Real GDP of fruit in year 2 (at year 1 prices)	= $11.50

The nominal quantity grows by 31% between year 1 and year 2. The real quantity grows by only 15% between year 1 and year 2. The difference is inflation: the change in the price level.

As has been noted above (see page 000), economists construct an alternative index number for the rate of inflation, the GDP deflator, from nominal GDP and real GDP. The procedure is:

- Calculate nominal GDP
- Calculate real GDP
- Divide the first number by the second; the quotient is the GDP deflator.

The GDP deflator is a Paasche index--the kind of index that tends to understate the effect on the price level of a rise in the price of a particular good. While the GDP deflator takes account of purchasers' ability to substitute away from items that have increased prices, it does not take account of the reduction in utility--the implicit cost to consumers--of settling for second best.

Intermediate Goods, Inventories, and Imputations

Intermediate Goods

GDP is defined as the market value of *final goods and services* produced. Thus so-called "intermediate goods"--goods sold to another business for use in further production--are excluded from GDP. A product made by one business and sold to another will eventually show up in the National Income and Product Accounts [NIPA] and be counted as part of GDP. It will show up when the second business sells its product (which will by then embody the value added by the first producer) to a consumer, an investor, a foreign purchaser, or the government. Meanwhile, because the value of an intermediate good is included in the price of the final good that the intermediate good is used to make, its value must be excluded from GDP.

For example, if a builder buys wood from a lumber mill to build a house, the value of the wood becomes part of the value of the house. To count the value of the wood again--to include the sale of the wood to the home builder as well as the sale of the newly-built house to its purchaser--would be to count the wood twice. And what would happen if the builder bought the lumber mill, so that he or she no longer had to buy finished would? GDP should not go down just because two businesses have merged.

One way to think about intermediate goods is that GDP represents the economic value-added at every stage of production. The value added by any one business is equal to the total value of the firm's products minus the value of the materials and intermediate goods the firm purchases. In computing value-added from start to finish, each intermediate good and service enters the calculation twice. It enters once with a plus sign, when the value-added of the business that made the good is calculated. It enters once with a minus sign, the value-added of the business that uses the good is calculated. Using this value-added approach, every good and service in the economy cancels out except those that are *not* sold to other businesses for use in the production process. These goods whose values do not cancel out are the *final gods and services*--consumption goods, goods purchased by the government, goods purchased as part of investment, and net exports.

Inventories

What happens if the production process is not finished when the end of the year rolls around, and the Commerce Department's Bureau of Economic Analysis closes the books on that year's GDP calculation? Some intermediate goods will not have been used to produce goods for final sale. The value has already been added in making the intermediate good, but no final good that embodies that value has yet been sold. The NIPA finesses this problem by treating inventories at the end of a period as a special kind of final good, a form of investment. A business that produces intermediate goods or final goods and doesn't sell them by the end of the year is treated as having "purchased" those goods for itself as part of its capital stock. The general rule is that whenever a business increases its end-of-period inventory, that increase is counted as a component of investment, and of final demand.

What happens the next year when the final goods are finished and sold? The value of those final goods sold become part of the next period's GDP. But the intermediate goods that went into them are counted as a negative investment, a disinvestment, in inventory. Thus the intermediate goods left over from this year and used next year are *subtracted* from next year's GDP.

Imputations

What about goods and services that are produced and consumed but not sold in the marketplace? Such goods and services lack prices and market values; how are they counted in GDP? In some cases national income accounts estimate--they guess, really--what goods or services would have sold for on the market if there had been a market.

The largest such "imputation" in the NIPA is found in housing. When somebody rents an apartment or a house, the rent they pay to the landlord becomes part of GDP as the purchase of "housing services" by the renter. When a landlord rents a house to a tenant, he or she is selling a service--the usefulness of having their roof over the renter's head--just as much as a barber is selling a service when a customer gets a haircut. Thus rent is one item in consumer spending on services. Accountants enter it as a component of expenditure in the FIRE (finance, insurance, and real estate) sector, a large component of consumer demand.

However, a little more than half of Americans own their own houses and are their own landlords. These homeowners do not write a monthly rent check to themselvs. Counting renter-occupied housing as part of GDP but ignoreingowner-occupied housing would not be consistent. Therefore GDP includes the *imputed* rent on owner-occupied dwellings--

the amount the Commerce Department's Bureau of Economic Analysis thinks that owner-occupied apartments and houses would rent for if they were rented out.

The inclusion of the cost of goods and services bought by the government may also be understood as an imputation. Since citizens do not directly pay the firefighters, police officers, judges, and other government employees directly, the value of what the government spends on firefighting--in wages, insurance, materials, and so forth--is counted in GDP..

Components of Real GDP

How does the Commerce Department's Bureau of Economic Analysis [BEA] construct its measure of real GDP? The Bureau includes in its measure of real GDP, which we will always denote by a Y in equations and diagrams, the values of:

- Goods and services that are ultimately bought and used by households (except for newly constructed buildings); these goods and services are termed consumption spending (denoted C).
- Goods and services (including newly constructed buildings) that become part of society's business or residential capital stock; these goods and services are termed investment spending (denoted I). Gross investment spending is divided into two parts: the capital consumption allowance, or the depreciation of worn-out or

obsolete capital; and net investment which increases the total capital stock. Investment can also be divided into four components: houses and apartments (residential structures), other buildings and infrastructure (non-residential structures), machines (producers' durable equipment), and as we noted above the change in business inventories.

Table 2.7: Components of Investment in the Third Quarter of 2000

Category of Investment	Billion Dollars, Annual Rate
Total Private Gross Investment Spending	$1,364
Residential Structures	$376
Non-Residential Structures	$246
Producers' Durable Equipment	$685
Change in Business Inventories	$57

Source: National Income and Product Accounts.

- Government purchases (denoted by G); note that government purchases do not include any payments the government makes that are not payment for a good or service provided to the government.
- Finally, net exports (denoted NX) are a balancing item included in GDP; the GDP total needs to be adjusted for the difference between exports and imports to make the National Income and Product Accounts consistent.

Accountants add up all of these components to arrive at GDP (see Table 2.8). This definition of GDP, the national income identity, is one of the most fundamental bases of macroeconomics:

$$Y = C + I + G + NX$$

This is the equation that you will write down more than any other during any any macroeconomics course.

Table 2.8: Components of GDP in the Third Quarter of 2000

Category of Investment	Billion Dollars, Annual Rate
Total GDP	$8,574
Consumption Spending	$5,847
Investment Spending	$1,364
Government Purchases	$1,492
Net Exports	$-166

Source: National Income and Product Accounts.

Goods (and services) produced abroad but consumed or used in the United States are imports. Goods (and services) produced in the United States and shipped abroad to be consumed or used there are gross exports. The distinction between gross exports and net exports is similar to the distrinction between gross investment and net investment. Gross exports are exports before the counterbalancing factor of imports have been subtracted.

Most often gross exports are less important than net exports--the difference between gross exports and imports, the net flow of goods into or out of the United States.

The final component of the national income identity, net exports, has been growing in relative size and importance. In the years just after World War II, imports and exports from the United States were about five percent of GDP. The United States was then more or less a closed economy. Macroeconomics textbooks gave short shrift to international trade and finance: it was not very important. Today imports and exports from the U.S. are about fifteen percent of GDP, three times as large a share as fifty years ago. The American economy is no longer a closed economy, and so international economics issues can no longer be downplayed.

What Is and Is Not in GDP

Depreciation and Net Output.

Real GDP is a very imperfect measure of total economic activity, or material well-being. Some things that are included in GDP should not be, and some things that are not included in GDP should be. For example, every year a portion of the nation's capital stock loses value. It wears out or becomes obsolete, so that it is no longer worth keeping it operating because the cost of keeping it operating is higher than the value of the goods it produces. Replacing such worn-out or obsolete capital is as much a cost of production to a business (or a government) as is meeting the business's payroll. Such replacement is surely not an *increase* in the nation's capital stock. Yet GDP counts *all* investment--

including this replacement investment--in its measure of total economic activity, for the measure of investment included in real GDP is gross investment.

Why is replacement investment included in real GDP? Why is it seen not as a cost of doing business but instead as the near-equivalent of building a new factory to expand the business's productive capacity? Depreciation expenditures are counted in real GDP because the statisticians who compile the NIPA have no confidence in their estimates of economy-wide depreciation. A better measure of economic activity is NDP, net domestic product, which includes only net investment and excludes depreciation. However, the national income accountants prefer to focus attention on measures that they think are reasonably accurate, and so downplay the (poorly measured) NDP and play up the GDP estimate.

Government Purchases

Government purchases of goods and services are also counted in GDP. The government uses the goods and services it purchases: it builds roads, provides police protection and courts, runs schools, issues weather reports, maintains the national parks, during the Cold War it maintained armies in West Germany to deter a Russian attack on Europe, and so on.

Many of these services, if they were provided by private businesses, would be counted as intermediate goods--things that are not of final value themselves but instead are aids to private-sector production. As such, they would be excluded from the GDP.

Think about it. Suppose two companies made a contract that a certain arbitrator would be the judge of any disputes that arose between them, and suppose they paid the arbitrator a retainer. The services of the private judge that they hired would be classified the NIPA as an *intermediate good*, and not included in the final goods and services added up to calculate GDP.

Nevertheless, *all* government purchases of goods and services are counted as part of GDP, including the money the government collects in taxes and then pays to its own judges, bailiffs, and clerks many of whom decide business-to-business disputes. A large chunk of government purchases fall into this category. They are counted as part of GDP, but would not be counted had they been made for analogous substantive purposes by private businesses.

What Isn't in GDP But Should Be

Moreover, many expenditures excluded from the NIPA, and thus from GDP, probably should not be. Production that takes place within the household is excluded from GDP. That is, the work family members do to keep their own households going, for which they are not paid, is excluded from GDP.

Figure 2.9: Labor Force Participation Rates by Gender, 1948-1996

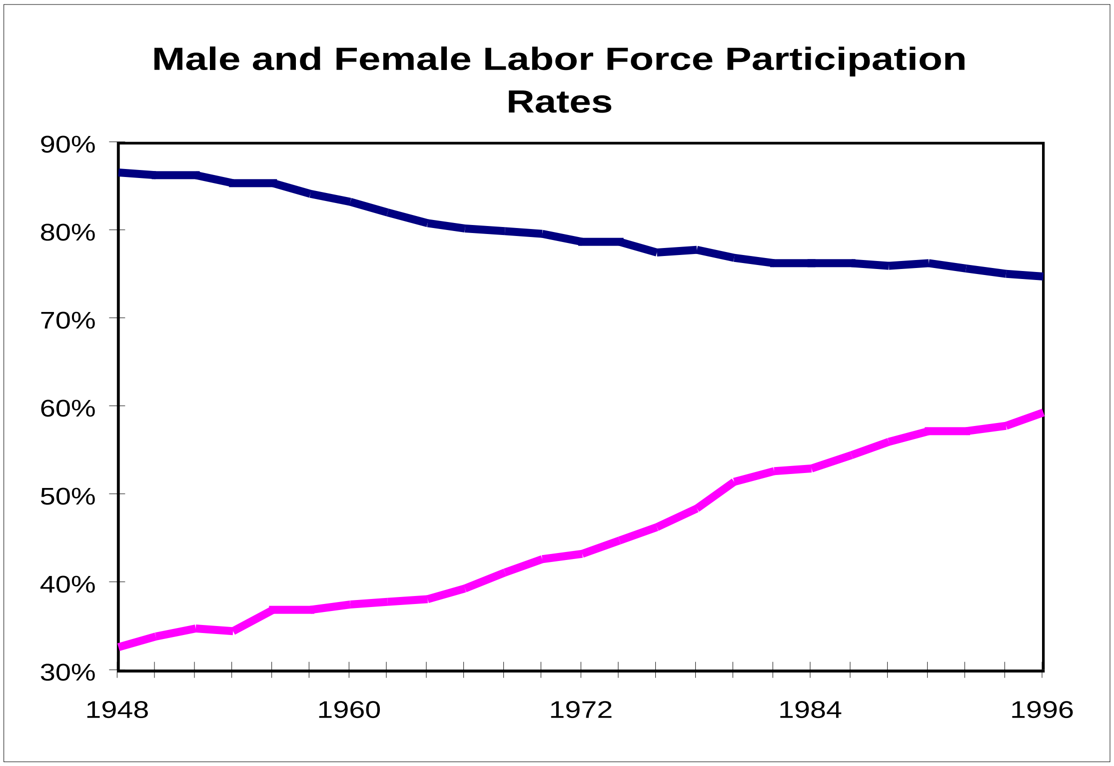


Figure Legend: The paid labor force participation rates of men and women have been converging for a generation, as male labor force participation has fallen slightly and female participation has grown rapidly. What were the counterparts of the women who worked for wages in 1996 doing back in 1948? They were working, but not for wages. But their work then wasn't counted as part of GDP.

Source: 1999 edition of the *Economic Report of the President* (Washington:

Government Printing Office).

This exclusion warps our picture of the U.S. economy. In 2000 some 129 million Americans, male and female, worked a total of about 206 billion paid hours (and some 7 million Americans spent a total of 5 billion hours looking for jobs). But many Americans--most of them adult women--will also spend at least 100 billion hours performing services--such as cooking, cleaning, shopping, and chauffeuring--that would count as employment and would count in GDP if they were receiving pay for them rather than doing them for their own families. As Figure 2.9 shows, only a little more than 30 percent of American women were counted in the labor force in 1948, even though most of them would have said that they worked a full day. Within-the-household production has never been counted as part of GDP. Back when the NIPA system was set up, economists believed that it would be difficult or impossible to obtain reasonable, credible, and defensible estimates of the economic value of within-the-household production.

Yet the exclusion of within-the-household production makes a difference not just for the level of national product but for its rate of growth. Over time the border between paid market and unpaid nonmarket, within-the-household work has shifted. Be suspicious of economic growth rates based on total GDP, GDP per capita, or GDP per adult, because they are distorted by the shifting dividing line between what people do and how they arrange their work. A meal cooked is a meal cooked whether it is part of the market paid work of a restaurant chef, or part of the unpaid work of a housewife. Over time the share of meals eaten prepared in the first way has grown, while the share of meals prepared in the second way has shrunk. This shift in the dividing line between home cooking and dining out has raised measured GDP. But the shift by itself is not an increase in society's wealth.

Depletion, Pollution, and "Bads"

Finally, the NIPA system makes no allowance for the depletion of scarce natural resources. To the extent that an economy produces a high income in the act of using up valuable natural resources, that income is not true GDP at all but the depletion of natural resources. Kuwait, Qatar, and Saudi Arabia have high levels of measured real GDP per worker, but much of their income arises not out of sustainable production but out of the sale of limited and depletable natural resources. A better system would have a category for the depletion of natural resources.

Moreover, the NIPA contain no category for the production of "bads"--things that you would rather *not* have. Producing more smog does not diminish GDP. The extra cases of lung cancer produced by cigarette smoking do not diminish GDP (indeed, they raise the medical care sector's contribution to GDP). If the demand for locks and alarm systems rises because crime increases, GDP increases. As noted before, GDP is a measure of the economy's level of productive effort only, not of well-being.

2.7 Chapter Summary

1. Because economics studies goods and services that flow through the market and are bought and sold with prices attached, economists have a lot of quantitative data to work with.

2. The real exchange rate is the relative price at which two countries' goods exchange for each other. You calculate it by adjusting the nominal exchange rate for changes in the price levels in the two countries.

3. The level of the stock market is a valuable summary index of a range of factors that affect investment: the current level of profits, investors' optimism or pessimism, the real rate of interest, and attitudes toward risk.

4. Real interest rates are much more important variables to keep track of than are nominal interest rates. You calculate the real interest rate by subtracting the rate of inflation from nominal interest rates.

5. The most commonly-seen measure of the price level is the Consumer Price Index [CPI]. The proportional rate of change of the price level is called the inflation rate.

6. Unemployment and total output are linked through Okun's law: a one percentage-point change in the unemployment rate comes with a two-and-a-half percent change in the level of output in the opposite direction.

7. Real GDP is the most commonly-seen measure of the overall level of economic activity. It is the value--calculated using market prices in some chosen base year--of all final goods and services produced in a year.

8. The line between GDP and not-GDP is principally the result of economists' beliefs in the 1940s and 1950s about what it would be possible to measure easily. It is not the result of a set of principled decisions about what kinds of activities should and should not be included in a measure of material welfare.

Important Concepts

Real GDP

NIPA

Consumption Spending

Investment Spending

Government Purchases

Net Exports

Inflation

Price Level

Index Numbers

Goods and Services

"Bads"

Real and Nominal

Bureau of Labor Statistics

Bureau of Economic Analysis

Analytical Exercises

1. In 1992 the components of nominal (and real) GDP were as follows:

$4.2198 trillion: consumption spending

$0.7904 trillion: gross investment spending

$0.6394 trillion: exports

$0.6690 trillion: imports

$1.2638 trillion: government purchases.

By 1993 these four components of spending had risen:

$4.4592 trillion: consumption spending,

$0.8762 trillion: gross investment spending

$0.6586 trillion: exports

$0.7193 trillion: imports

$1.2834 trillion: government purchases.

Moreover, prices had also risen: the price index for consumption rose from 100 to 102.8; the price index for investment rose from 100 to 107.6; the price index for government purchases fell from 100 to 99.1; the price index for exports rose from 100 to 102.9; and the price index for imports rose from 100 to 108.9.

a. What was real GDP (measured at 1992 prices) in 1993? How much was real GDP growth between 1992 and 1993?

b. Which is the more important measure for assessing an economy's performance, real GDP or nominal GDP? Why?

2. Are capital goods--large turbine generators, jet airliners, bay-spanning bridges--intermediate goods or final goods? How are they included in GDP?

3. Why are so-called "intermediate" goods treated differently than "final" goods in the National Income and Product Accounts [NIPA]?

4. How does the labor and other factors of production that go into producing intermediate goods get ultimately counted in GDP?

5. Why are imports subtracted from the sum of consumption, government purchases, investment, and exports to get to GDP?

6. Explain whether or not and why the following items are included in the calculation of GDP:

A. Increases in business inventories

B. Sales of existing homes

C. The fees earned by real estate agents on selling existing homes

D. Income earned by Americans living and working abroad

E. Purchases of IBM stock by your brother

F. Purchase of a new tank by the Department of Defense

G. Rent that you pay to your landlord

7. What are the major components of GDP?

8. Which interest rate concept--the nominal interest rate or the real interest rate--do lenders and borrowers care more about? Why?

9. Which is the more important measure for assessing an economy's performance, real GDP or nominal GDP?

10. Why do you calculate real GDP by *dividing* nominal GDP by the price level, but calculate the real interest rate by *subtracting* the inflation rate from the nominal interest rate. Since both sets of calculation aim to transform a real into a nominal quantity, shouldn't they be calculated in a parallel fashion? So why divide in one case, and subtract in the other?

Policy-Relevant Exercises

1. In 1979 the (short-term) nominal interest rate on three-month Treasury bills averaged 10.0%, and the GDP deflator rose from 50.88 to 55.22. What was the annual rate of inflation in 1979? What was the real interest rate in 1979?

   a. Were real interest rates higher in 1979, or in 1998 (when the (short-term) nominal interest rate on three-month Treasury bills was 4.8%, and the inflation rate was 2.6%?

   b. Which interest rate concept--the nominal interest rate or the real interest rate--do lenders and borrowers care more about? Why?

2. In 1997 nominal GDP was equal to $8.1109 trillion; consumption spending was $5.4937 trillion; gross investment spending was $1.256 trillion; and government purchases were $1.4546 trillion. What was the level of net exports?

3. Suppose that the applicance store buys a refrigerator from the manufacturer on December 15, 2003 for $600, and that you then buy that refrigerator on January 15, 2004 for $750.

   a. What is the contribution to GDP in 2003?

   b. How is the refrigerator accounted for in the NIPA in 2003?

   c. What is the contribution to GDP in 2004?

   d. How is the refrigerator accounted for in the NIPA in 2004?

4. In 1992 the components of nominal (and real) GDP were as follows:

$4.2198 trillion: consumption spending;

$0.7904 trillion: gross investment spending;

$0.6394 trillion: exports;

$0.6690 trillion: imports;

and $1.2638 trillion: government purchases.

By 1993 these four components of spending had risen: $4.4592 trillion in consumption spending, $0.8762 trillion in gross investment spending, $0.6586 trillion in exports, $0.7193 trillion in imports, and $1.2834 trillion in government purchases.

Moreover, prices had also risen: the price index for consumption rose from 100 to 102.8; the price index for investment rose from 100 to 107.6; the price index for government purchases fell from 100 to 99.1; the price index for exports rose from 100 to 102.9; and the price index for imports rose from 100 to 108.9.

What was real GDP (measured at 1992 prices) in 1993? How much was real GDP growth between 1992 and 1993?

5. In 1998 the GDP deflator rose at an annual rate of 2.6%, and the short-term interest rate on three-month Treasury bills averaged 4.8% What was the (short-term) nominal interest rate in 1998? What was the (short-term) real interest rate in 1998?

6. In 1992 the implicit GDP deflator (in 1992 dollars) was equal to 100. In 1993 it was equal to 102.64. What was the annual rate of inflation between 1992 and 1993?

In 1993 the implicit GDP deflator (in 1992 dollars) was equal to 102.64. In 1994 the implicit GDP deflator was 105.09. What was the annual rate of inflation between 1993 and 1994?

7. In 1992 the implicit GDP deflator (in 1992 dollars) was equal to 100. In 1997 it was equal to 111.57. What was the average rate of annual inflation between 1992 and 1997? Why was it less than (11.57/100)/5--one fifth of the total change in the price level between 1992 and 1997?

8. In 1992 both nominal GDP and real GDP (measured in 1992 dollars) were equal to $6.2444 trillion. By 1997 nominal GDP had risen to $8.1109 trillion, and the implicit GDP deflator had risen to 111.57. What was real GDP in 1997? What was the average rate of real GDP growth between 1992 and 1997?

9. In 1960 real GDP (in 1992 dollars) was $2.2629, in 1970 it was $3.3976 trillion, in 1980 it was $4.615 trillion, and in 1990 it was $6.1363 trillion. Also, in 1960 the labor force was 69.6 million, in 1970 82.8 million, in 1980 106.9 million, and in 1990 125.8 million. What was real GDP per worker in 1960, 1970, 1980, and 1990? How fast did real GDP per worker grow between 1960 and 1970? Between 1970 and 1980? Between 1980 and 1990?

10. In 1979 the (short-term) nominal interest rate on three-month Treasury bills averaged 10.0%, and the GDP deflator rose from 50.88 to 55.22. What was the annual rate of inflation in 1979? What was the real interest rate in 1979? Were real interest rates higher

in 1979, or in 1998 (when the (short-term) nominal interest rate on three-month Treasury bills was 4.8%, and the inflation rate was 2.6%?