Lecture 2: Key Economic Variables and Concepts

We want to discuss some important variables that we will use throughout this course. Specifically, we want to accomplish three tasks

- Show how economists measure aggregate output or Gross Domestic Product (GDP)
- Distinguish between Real GDP and Nominal GDP. This leads to a discussion of how the inflation rate is measured.
- Show how economists measure unemployment and business cycles.

Gross Domestic Product

A nation's aggregate output, or **Gross Domestic Product**, is simply the value of all **final** goods and services produced in that country in a year. To give a simple example, consider Miller's Pizzeria, which sells both plain and pepperoni pizzas. While most pizzerias offer more than two varieties, let us keep the story simple. Table 2-1 gives data on this year's pizza sales.

Table 2-1
An Example of How GDP Is Calculated:
Sales This Year at Miller's Pizzeria

Type of Pizza	Units Produced	Market Price	Total Sales $
Plain	10,000	$8.00	$80,000
Pepperoni	8,000	$10.00	$80,000
GDP			$160,000

If Miller's Pizzeria were the only business in the nation, computing GDP would be quite simple: we would add up sales and compute GDP as $160,000.

Warning required by the Economist-General:

- We use the example of a pizzeria for much of this course, so be prepared to return to the example. We call our store "Miller's Pizzeria" after the late Merton Miller, who, mindful of the desire of journalists for an instant sound bite, explained the basis of his 1990 Nobel Prize in Economics by saying: "If you cut a pizza into eight slices and put the slices back together, you still have a pizza." While Miller was speaking in a slightly different context (capital markets), the point applies here. The fundamentals of our economy are simply those of our simple pizzeria. While there are some complications we point out as we go along it is best to remember the basics.

Final and Intermediate Goods

There are complications. While it might be fanciful to think of Miller's Pizzeria as the only business in town, it does not make pizzas out of thin air. It requires ingredients, workers, and a place of business. These are **intermediate goods**, and not, like the pizzas, **final goods**. If we counted intermediate goods in computing GPD, we have the potential to engage in horrendous double counting. Consider the number of times that a grain of wheat sells and resells along the way from a Kansas wheat farm to Miller's Pizzeria.

Here, the adjustment for final and intermediate goods is quite simple: we ignore them. In real life, the problem is not so simple. Cheese, for instance is both a final good and an intermediate good.

Economists account for these intermediate goods by using a concept called **Value Added** to calculate GDP. A firm's Value Added is the difference between what sells its goods and services for and what it pays for the goods and services it buys from other businesses. By definition, Value Added equals the sum of

- Wages to workers
- Payments to the owners of the capital in the business (Capital is defined as plants, equipment, and machinery used in the production of goods and services.)
- Profits to the owners

We can expand our example to illustrate Value Added, show how we measure final goods, and at the same time, make a couple of other important

points about GDP. Recall that Miller's Pizzeria has sales for the year of $160,000. Suppose that

- The Pizzeria purchases all its ingredients, from Farmer Jones for $90,000, pays $20,000 rent to building owner, with the remaining $50,000 going as wages to either the employees or the owner of the Pizzeria. (While the idea that Farmer Jones sells all the ingredients is as fanciful as the idea that the Pizzeria requires no electricity or water, we want to keep the story simple).

- Farmer Jones uses his $90,000 as follows: $20,000 goes to Wonder Seed and Fertilizer for seed and fertilizer; $30,000 goes to the landowner from whom Farmer Jones rents the land; the remaining $40,000 represents Farmer Jones' income.

- To keep the story simple, we assume that Wonder Seed and Fertilizer makes its products out of thin air. The entire $20,000 represents profits to the company's owner.

Given these assumptions, Table 2-2 shows the calculation of GDP. The last two columns break Valued Added down into Wage Income and Capital Income.

Table 2-2
Distinguishing between Final and Intermediate Goods in Computing GDP

Transaction	Amount	Cost of Inputs	Value Added	Wage Income	Capital Income	Total Income
Sale of Pizzas by Miller's	**$160,000**	$90,000	$70,000	$50,000	$20,000	$70,000
Sales of Ingredients by Farmer Jones To Miller's	$90,000	$20,000	$70,000	$40,000	$30,000	$70,000
Sale by Wonder Seed of seed and Fertilizer to Farmer Jones	$20,000	0	$20,000	20,000		$20,000
Total	$270,000	$110,000	**$160,000**	$110,000	$50,000	**$160,000**

Note two key points.

- Income equals product
- Value Added equals Income equals product

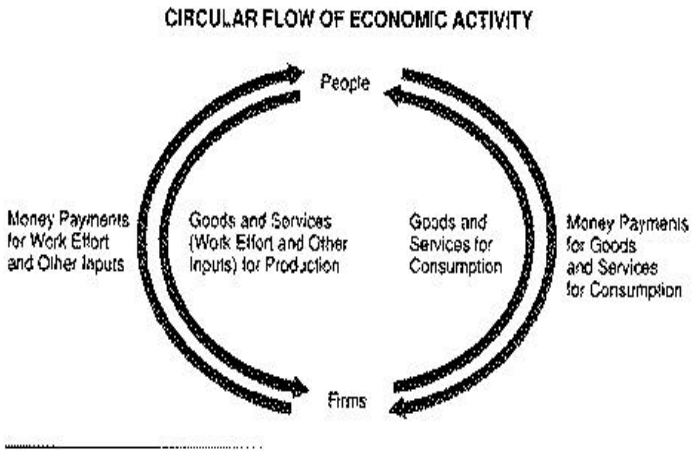
Income Equals Product

As you will note, total income also equals $160,000, the value of Gross Domestic Product. Thus the key identity:

Everything that is Produced = Someone's Income

The reason is important. Ultimately people do all spending, and people get all income. Since people's income must equal their expenditures, (including saving as an expenditure) income and expenditures must balance. Economists sometimes put this in terms of a simple graph, showing how funds and resources move between households and firms. Figure 2-1 shows the flow of products between consumers and producers, as well as the flow of incomes and payments.

Figure 2-1
The Circular Flow Diagram



The outer arrows show the direction flows of money in return for goods and services and factor payments, the purchase of which is represented by the inner arrows.

Value Added equals Product equals Income

This conclusion should be no surprise. The people who create the value, whether they are workers, business entrepreneurs, or the people who own the buildings, plants, machinery and the like used in the business get its income. Since Value Added equals income for every business, it is not surprising that it works for the economy as a whole as well.

It is no accident that the value added equals both GDP and Income. In our simple example, we can easily identify final product. In real life, it is not quite so easy. Almost every product we can think of is both a final product and an intermediate product. The practical technique that economists use to calculate GDP is to measure value added at every firm (or at least, using modern statistical techniques, of a sample of all firms). Thus we count the cheese Farmer Jones sells (net of the cost of the goods he purchases to produce the cheese) as part of GDP. We avoid double counting the cheese used in pizzas by subtracting it as when we compute value added for Miller's Pizzeria.

Real and Nominal GDP

Mark Twain once said that the two things that were certain were Death and Taxes. Were Twain alive today, he would doubtless add a third thing: Prices Change. Because they do, comparisons of GDP over time are not simple. If Miller's Pizzeria only sold plain pizzas, we might get a table looking like the following:

Table 2-3
Price and Sales Data for Miller's Pizzeria for two years

Year	*Pizzas*	*Price of Pizza*	*GDP*
Last Year	8,000	$6	$48,000
This Year	10,000	$8	$80,000
Change	25%	33%	67%

We would compute this year's GDP as $80,000, while last year's was $48,000. The $32,000 increase would amount to a $32,000/$48,000 = 67% increase in GDP. There is a simple fallacy in this calculation. It is the number of pizzas that matter, and pizza production has risen only 25% from 8,000 to 10,000. The difference is due to the pernicious effects of inflation.

Economists adjust for this by use of two different measure of GDP: **Nominal Gross Domestic Product** and **Real Gross Domestic Product**.

- **Nominal Gross Domestic Product** is the value of all final goods and services products in any year, valued at the prices the goods sold for that year.

- **Real Gross Domestic Product** is the value of final goods and services in any year, valued at the prices the goods sold for in some base year.

To see an example of this, look at the inside cover of the text, which reports both GDP (billions of dollars) and GDP (billions of 1997 dollars). The first item is nominal GDP, while the second is real GDP. If we want to compare how much more goods and services we have now than say in 1990, we want to use Real GDP.

There is nothing magic about using 1997 dollars. You will frequently see discussions of GDP (1985$) or GDP (1992$). These are also measures of real GDP, but using 1985 or 1992 prices. In the case of our simple example, we could have either Real GDP stated in terms of this year's prices or Real GDP stated in terms of last year's prices. If you will, we can call these GDP (TY) or GDP (LY). Table 2-4 gives two possible values for real GDP.

Table 2-4
Nominal and Real GDP for Miller's Pizzeria for two years

Year	*Nominal GDP*	*Real GDP (LY)*	*Real GDP (TY)*
Last Year	48,000	$48,000	$64,000
This Year	80,000	$60,000	$80,000
Change in Real GDP		$12,000	$16,000
% Change		$12,000/ $48,000 = 25%	$16,000/ $64,000 = 25%

No matter which way we do it, real GDP is up 25 percent.

In fact, this is usually not the case. To see why, recall that Miller's Pizzeria actually sells both plain and pepperoni pizza. Table 2-5 gives the data on pizza prices and sales:

Table 2-5
Price and Sales Data for Miller's Pizzeria

Commodity	***Sales Last Year***	***Prices Last Year***	***Sales This Year***	***Prices This Year***
Plain	6,000	$6	10,000	$8
Pepperoni	8,000	$8	8,000	$10
Nominal GDP, Last Year		***$100,000***		
Nominal GDP, This Year				***$160,000***

Nominal GDP has risen 60% from $100,000 to $160,000. As to how much real GDP has risen, that is either 24% or 25% depending on which year you choose as a base year. Table 2-6 shows GDP for both years, valued in either this year's prices or last year's prices.

Table 2-6
Two Measures of Real GDP

GDP	*Valued at Last Year's Prices*	*Valued at This Year's Prices*
Last Year's Quantity	$100,000	$128,000
This Year's Quantity	$124,000	$160,000
Percent Change	124,000/100,000 = 24%	160,000/128,000 = 25%

When we do the calculation of the change in Real GDP, we get two different answers. Using last year's prices, GDP has risen from $100,000 to $124,000 or 24%. Using this year's prices, GDP has risen from $128,000 to $160,000 or 25%.

Table 2-7 shows two measures of something called the **GDP deflator**. The GDP deflator is simply the ratio of Nominal GDP to real GDP. Its value depends on which year we use as our base year for computing Real GDP.

- If we use last year's prices to compute real GDP, so that last year is the base year, then last year's GDP deflator is 100. Remember in the base year real and nominal GDP are equal.100,000/100,000 = 1 or 100% or 100.

- With last year as the base year, this year's GDP deflator is the ratio of this year's Nominal GDP to this years Real GDP or $160,000/ $124,000 = 1.29 or 129% or 129.

- If we use this year's prices to compute real GDP, so that this year is the base year, then this year's GDP deflator is 100. Remember, real and nominal GDP are equal in the base year. 160,000/160,000 = 1 or 100% or 100

- With this year as the base year, then last year's real GDP deflator is the ratio of last years real GDP to last years nominal GDP. $100,000/$128,000 = .78 or 78% or 78.

Table 2-7
Two Measures of GDP Deflator

GDP Deflator	*Using Last Year as Base Year*	*Using This year as Base Year*
Last Year	100	78
This Year	129	100

In either case, the percent change in the GDP deflator gives us an inflation index. Here, the two deflators give us two different answers.

If we use a deflator computed using last year's prices as our base year, we compute the percent rise in the GDP deflator as (100-78)/78 = 28%. If we use a deflator computed using this year's prices, we compute the percent rise in the GDP deflator as (129-100)/100 = 29%.

That is, in one case, we say inflation was 29%. In the other case, we say inflation was 28%. Which measure should we use? That is a complicated question. Traditionally the government has used the first method, using a previous year's prices as a base year. Economists can show – though the proof is beyond this course – that this method overstates the true inflation rate, while the second method understates the inflation rate. Thus, we know for sure that the government's method has consistently overstated the inflation rate.

How much has the government overstated inflation? Read on.

The Consumer Price Index

The **Consumer Price Index (CPI)** is another common measure of inflation. In fact, it gets the most coverage in public discussions of inflation.

Unlike the GDP Deflator, based on all goods and services in the economy, the CPI measures the change in the price of a market basket of commodities consumed by a "typical" consumer. (From time to time, the Bureau of Labor Statistics, a division of the US Department of Labor charged with measuring the CPI surveys consumers to see what commodities a typical consumer consumes.) Then each year the BLS goes out and buys the exact same goods and services from the exact same places and calculates the increase in prices from the previous year.

Problems with the Inflation Indices

Each measure of inflation has its strengths and weaknesses, but we need not bother ourselves here with a discussion of the technical merits of the different indices. Instead, let us consider some basic problems with all of the deflators. Here are a few:

Table 2-8
The Joys of Computing A Price Index

Changes in Quality	This year, Miller's Pizzeria has increased the amount of cheese on each of its pizzas. While pizza might be a silly example, it is a real problem since the quality of many commodities changes over time. A day in the hospital, for instance, is not the same as a day in the hospital 40 years ago
New Products	This year, Miller's Pizzeria has broadened its product line to include the Blonde Norwegian, made with ham and apple slices. It is selling nicely. How do you account for the introduction of new goods?
New Outlets	Last year, you had to drive 50 miles to Miller's pizzeria. This year, it has opened a second store, just down the street. While the prices are the same, the full cost, which includes travel cost, is down substantially.
Substitution	If some prices rise by more than others, consumers are likely to substitute the cheaper good for the more expensive one. If the price of Pepsi rises then many will switch to cheaper coke. How should we account for this substitution?

Recently a commission chaired by Michael Boskin, a Stanford economist, studied the inflation indices. They concluded that the CPI overstated the inflation rate. Here are their mid-point estimates of the errors.

- Failure to adjust for the substitution effect overstated the inflation rate by 0.4% a year.
- Failure to adjust for new products and improved quality overstated the inflation rate by 0.6% a year.
- Failure to adjust for new outlets overstated the inflation rate by 0.1% a year.

Overall, the commission found that inflation was overstated by 1.1%. The BLS (Bureau of Labor Statistics) is considering adjustments to correct for some of these problems.

A Final Note

Constructing inflation indices is a tough job, and we should beware of cheap shots. Nevertheless, it is true that the inflation indices overstate inflation, perhaps by one percentage point or more.

Does a percentage point a year really matter? Yes it does. Effectively we compute the year to year changes in Real GDP by computing the nominal change in GDP and then subtracting out an allowance for inflation, whether based on the GDP deflator, the CPI or some other measure of inflation. Suppose:

- Nominal GDP has been growing at (say) six percent a year for the past several years and
- We have been estimating inflation at (say) three percent a year.

Then we have been computing the change in real GDP as three percent a year. If, in fact, the true inflation rate has been only two percent per year, thus the rate of growth in real GDP has actually been four percent per year.

While a percent a year may not sound like much, it adds up. Over the past ten years, for example, it would indicate that we have understated real GDP growth by over ten percent.

Other Problems with GDP

Shortcomings with GDP as a Measure of National Well Being

Gross Domestic Product has some conceptual limitations as a measure of national well being.

- GDP includes only market activities. It does not include
    - Illegal activities such as gambling or drugs
    - The underground economy, otherwise legal activities unreported to avoid income taxes. (For example, I hire someone to paint my house and pay in cash, so that the painter need not report the income to the IRS).
    - Home-based production. (I paint the house myself).
- GDP measures resources, and not national well being. If the level of pollution, for example goes up or down, our well being changes, but GDP does not reflect that.

The real concern is that the level of these activities has changed over time. If they remain constant as a percentage of GDP, we would be able to say that the doubling of GDP represented a doubling of economic activity.

Some examples of changes over time

- Women enter the labor force and then buy traditional household services. (Hiring a cleaning woman would be a good example.) Their work now counts as part of GDP, whereas their work as homemakers did not.
- People engage in do-it-yourself activities. That is they no longer work Saturdays but work around the home.
- As taxes increase, more production is driven underground.

Warning required by the Economist-General:

- We should be aware of the shortcomings of GDP as a measure of well being, but it is still the "best game in town".

Some Data on GDP

When we actually look at GDP, expressed as "Y", and not just pizzas, we tend to break it down into some basic categories of final goods:

- Consumption of Goods and Services, expressed as "C", and broken down into:
  - Durables,
  - Non-durables, and
  - Services
- Investment, expressed as "I", broken down into:
  - Inventory Investment,
  - Fixed Non-Residential Investment, and
  - Fixed Residential Investment
- Government (Federal, State and Local) Purchases of Goods and Services, expressed as "G"
- Net Exports (Exports minus Imports), expressed as (EX-IM) or (NEX) or (X-M)

The Basic Equation

Economists often summarize this discussion in a single equation:

$$Y = C + I + G + X\text{-}M$$

That is GDP (Y) goes either for Consumption (C), Investment (I), Government purchases of goods and services (G), or net exports, eXports minus iMports (X-M). Another way of putting this equation may be more helpful:

$$Y + M = C + I + G + X$$

That is, our potential spending is our GDP, Y, plus our imports M. It goes either for C, I, G, or X. While not a standard way of putting the equation, some people find this way more helpful.

Some Data

Table 2-9 gives some recent data on GDP and its components and compares them to the numbers from 40 years ago. We should note some general themes:

- GDP has grown significantly since 1960, even after allowing for inflation. In 1996 prices, the change is from $2,357.2 billion to $8861.0 billion, almost quadrupling real GDP in 40 years.
- Consumption as a percent of GDP has grown by about five percent. However, there has been a significant shift from consumer nondurables to services.
- Investment as a percent of GDP has increased 3%.
- Government purchases of goods and services, as a percent of GDP, has shrunk about four percent. In part, this masks a shift from defense to non-defense spending, as well as a growth in transfer payments, which do not show here. Also, there has been a shift away from federal government purchases to state and local government purchases.
- The international sector has exploded, more than doubling as a percent of GDP. Exports, for instance, rose from 5 to 11 percent of GDP.

Table 2-9
1999 and 1960 Nominal GDP Compared
(Billions of $ or Percent of GDP)

	1999	*1999(%)*	*1960*	*1960(%)*
Gross Domestic Product	**9248.4**	**100%**	**527.4**	**100%**
Consumption	**6254.9**	**68%**	**332.2**	**63%**
Durables	758.1	8%	43.2	8%
Nondurables	1841.1	20%	152.9	29%
Services	3655.7	40%	136.1	26%
Investment	**1621.6**	**18%**	**78.9**	**15%**
Fixed Investment	1577.4	17%	75.7	14%
Nonresidential	1166.5	13%	49.4	9%
Residential	410.9	4%	26.3	5%
Inventory Inv.	44.3	1%	3.2	1%
Govt. Purchases	**1628.7**	**18%**	**113.8**	**22%**
Federal	570.8	6%	65.9	13%
State and Local	1057.9	11%	47.9	9%

Net Exports	**-256.8**	**-3%**	**2.4**	**1%**
Exports	996.3	11%	25.3	5%
Imports	1253.1	14%	22.8	4%

Per capita GDP

We often divide GDP by population (per capita GDP) in order to know something about a country's standard of living. This number is useful for making comparisons of the standard of living over time, as well as for making international comparisons. It is misleading to compare nations solely based on GDP. Suppose two countries, A and B, have a GDP of $1.0 Trillion, but populations of 25 million and 1 billion, respectively. Then:

- Per Capita GDP of Country A = one Trillion/ 25 million = $40,000.
- Per Capita GDP of Country B = one Trillion/ 1 Billion = $1,000.

In short, there is a large difference in the amount of goods and services available to each citizen.

Table 2-10 presents historical data on Real US per capita GDP.

Table 2-10
Over time, Per Capita GDP has grown significantly

Year	Per Capita GDP (1985$)
1820	1,051
1870	2,254
1890	3,115
1913	4,868
1929	6,336
1938	5,568
1950	8,611
1960	9,995
1973	14,103
1985	17,667
1999	24,032

The increase from 1820 to 1999 represents a compound growth rate of 1.8% per year. In other words, GDP has grown faster than the population,

allowing our standard of living to increase twenty-fold since 1820. While 1.8% per year may seem like a small number, it adds up over time.

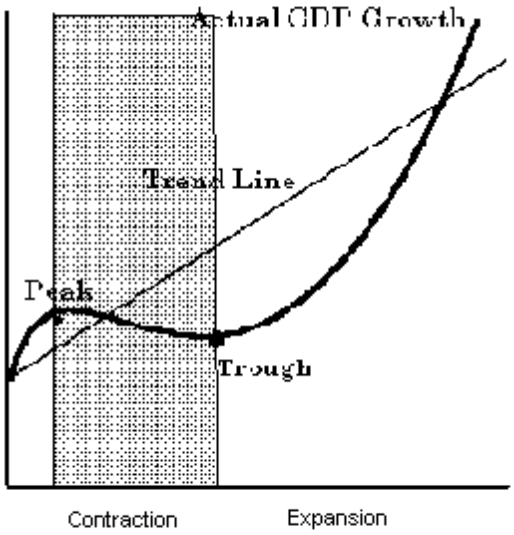
Economic Fluctuations, Recessions, and Unemployment

The dramatic growth in GDP may lead us to conclude that GDP – at least on a per capita basis – always goes up. In fact, that is not the case. While the general trend is up, there are periods during our history when GDP has actually declined, and economists talk about the cyclical nature of our economy.

Business Cycles

Figure 2-2 illustrates the situation. The economy has both periods of economic growth as well as periods of economic decline. A peak occurs when the economy stops growing and begins declining for two consecutive quarters, and goes into a recession. A trough occurs when the economy stops declining and begins growing for one quarter. We have more to say about these cycles later. Following a standard convention, Figure 2-2, shades the recession period, or period of contraction.

Figure 2-2
Peaks and Troughs in the Economy



The economy does not grow at a constant rate. When it is growing, we say it is expanding. When it is declining, we say it is contracting. When the economy switches from expanding to contracting, we say it has a peak. When it switches from contraction to expansion, we say it has a trough. The shaded period here represents a recession or period of business contraction.

Unemployment

The unemployment rate fluctuates over time, generally rising during periods when GDP is declining or at least not growing very fast and falling during periods of economic growth. We say that the unemployment rates is countercyclical. Table 2-12 shows the data on annual unemployment rates.

Table 2-12
Civilian Unemployment Rate by Year

1948	*3.8%*	1960	*5.5%*	1972	*5.6%*	1984	*7.5%*	*1996*	*5.4%*
1949	*5.9%*	1961	*6.7%*	1973	*4.9%*	1985	*7.2%*	*1997*	*4.9%*

1950	*5.3%*	1962	*5.5%*	1974	*5.6%*	1986	*7.0%*	*1998*	*4.5%*
1951	*3.3%*	1963	*5.7%*	1975	*8.5%*	1987	*6.2%*	*1999*	*4.2%*
1952	*3.0%*	1964	*5.2%*	1976	*7.7%*	1988	*5.5%*		
1953	*2.9%*	1965	*4.5%*	1977	*7.1%*	1989	*5.3%*		
1954	*5.5%*	1966	*3.8%*	1978	*6.1%*	1990	*5.6%*		
1955	*4.4%*	1967	*3.8%*	1979	*5.8%*	1991	*6.8%*		
1956	*4.1%*	1968	*3.6%*	1980	*7.1%*	1992	*7.5%*		
1957	*4.3%*	1969	*3.5%*	1981	*7.6%*	1993	*6.9%*		
1958	*6.8%*	1970	*4.9%*	1982	*9.7%*	1994	*6.1%*		
1959	*5.5%*	1971	*5.9%*	1983	*9.6%*	1995	*5.6%*		

Note: all of these data are seasonally adjusted to adjust for

- The rise in the number of unemployed when school lets out and
- The employment surge at the Christmas selling season, as well as other factors

This is not the place to have a detailed discussion of the causes of unemployment. Obviously, there will always be some unemployment. People are constantly entering -- and reentering -- the labor force, changing jobs, and jobs are constantly disappearing. We will turn to a more detailed discussion of unemployment in later lectures.

Relation to the Text

Each lecture ends with a section relating it to the text. In some cases, material is omitted, either because the text covers it well enough or because it is not worth learning. In other cases, material is added. Each of these "lectures" will end with a brief note relating the lecture to the text, describing what material is left to the student to learn alone and what material may safely be skipped.

Which Chapters does this lecture cover?

Section from Stockman	Coverage
Ch. 5, Total Production of Goods and Services	Covered
Ch. 5, The Economy's Total Spending and Income	Covered

Ch. 5, GDP, Employment and Unemployment	Covered briefly, will be covered more in Lecture 3
Ch. 5, Measuring the Price Level	Covered
Ch. 5, Appendix: Measuring Production and Income: National Income Accounting	Covered

What material is new?

Data on American GDP in more detail as well as more discussion of inflation. However do not feel obliged to memorize these data.

The detailed discussion of problems in computing inflation rates is new. These computations are currently a "hot" topic in Congress.