

Chapter 2

Gross Domestic Product

We need to start with some basic definitions. This first step may not be all that exciting. But, I remind you, if you expect the paint to last, you will need to spend a lot of time preparing the surface. I know you want to slap on the paint right away, but you will regret it if you do not show a little patience.

Stick with me here. It will get better soon.

2.1 Definitions

2.1.1 GDP Is an Imperfect Measure of Economic/ Material Success

The first focus of our attention is *Gross Domestic Product* (GDP). *GDP is the market value of goods and services produced within a selected geographic area (usually a country) in a selected interval in time (often a year).* Rightly or wrongly, this has become the standard by which we measure the size and health of a country. Big and/or growing are good. Small and/or shrinking are bad. For example, California politicians are fond of informing the voters: If California were a country, it would rank 7th on the GDP list. Whooo, whooo! Go, California.

As we are about to repeat these three letters a couple thousand times, it is wise to put firmly into our consciousness the fact that GDP is a very imperfect indicator of the health of countries. One big problem is that GDP measures only the material, not the emotional or the spiritual, or . . . If it is produced and sold, then it is counted; otherwise not. Driving along Sunset Boulevard in your fancy car and wearing your fancy clothes, you probably don't realize it yet, but "You can't buy love." If you could, the accountants would include "love services" in GDP. (I know what you are thinking, but that is not love.)

Another issue is that GDP is about outcomes rather than processes. Most of us do care about *how* we got the goods and services we consume as well as *what* we consume. We think the process out to be just and fair. But GDP does not include

justice or fairness. And GDP does not account for the joy of giving. The pleasure I derive from giving you the cookies I baked is not counted in GDP, nor is the extra smile on your face thinking about me baking those cookies for you. Even the cookies do not count unless I sell them to you. There has to be a market transaction. What would be the fun of that?

2.1.1.1 Adjustments to GDP

GDP is not happiness, that's for sure, but even limited to its material domain, GDP *excludes* much that is valuable, and *includes* much that is really unwanted. Most alarmingly, GDP does not subtract the annoyance that you suffer from your long hours of work, or the loneliness of your children. If your health deteriorates, but you stay on the job, GDP will also increase because someone has to produce all those pills and doctor visits that you purchase. Likewise, GDP increases when crime increases, because we have to pay the police for their overtime work. And damage to the environment is not subtracted from GDP. Neither is increased congestion nor the health consequences of more smoking. If some one produced it, and you bought it, it counts. If what you buy has unintended consequences, for you or for the rest of us, that does not matter. It is only the market value that counts. No market, no market value.

There is much that should be subtracted from GDP, of course, but there is something extremely important that should be added – “consumer surplus.” When we use market prices to value output, we ignore the fact that items generally are purchased because they are worth *more* than the price we pay. Only “at the margin” is value equal to price. To get this idea of the margin, think about drinking water. The margin is the last glass of water you drink each day – the eighth glass. The first glass of water has virtually unlimited value since you could not live without it. The second glass is less valuable and the third less valuable still. According to an economic model of personal decision-making, you will drink additional glasses of water until the benefits of another glass are less than the cost. Most of us live in communities where water is very cheap. My statement from the Department of Water and Power indicates that I am charged \$0.03 per gallon. The half-gallon of water that I drink each day is valued in GDP at the market rate of only about \$0.015 per day, when its value to me is staggeringly high. Do you know the old joke: an economist is someone who knows the price of everything but the value of nothing. But, actually, we quite well understand that the price of water is low, but the value is immense.

The difference between the market value and the full value is really dramatic for all the information delivered to you over the Internet. Since it is provided for free, its market value is zero, and it is not included in GDP at all.

2.1.1.2 Gross Domestic Happiness

Clearly, GDP and well-being are not the same. Since GDP was first defined, Social Scientists have been trying to find a useful alternative that accurately measures

Gross National Well-being. Try doing a Web search on “GDP and Happiness” to see the vast sea of possibilities.

The problem is measurement. We can measure pretty accurately the market value of the automobiles produced in the United States, but how much do those new vehicles contribute to well-being? Keep in mind that those cars fundamentally change our lifestyles, confining us alone in metal boxes for many hours of the day. Is that well-being?

But happiness is a slippery concept. What you call happiness may not be anything like what I call happiness. That makes it difficult for me to tell if you are happy. But I can ask. The General Social Survey in the US asks: “Taken all together, how would you say things are these days – would you say you are very happy, pretty happy, or not too happy”. When you report to this survey taker that you are “very happy” and I report that I am “pretty happy” whatever does that mean? What does it mean, especially, if you and I come from different cultures and use different languages?¹

Material Success May or May not Correlate with Happiness

“So what?,” most economists would retort. Though “you can’t buy love,” you can buy a pretty good facsimile. Of course, material well-being is not everything, but for a lot of people it seems pretty close.

But there is a problem with material pursuits. For many of the materialists it is not their material well-being that matters; it is how much better they are doing than their neighbors. Like bird-watching. The pleasure comes from seeing a bird that others have not seen. How mean-spirited is that? If all that matters is where we are in the material pecking-order, then when we all get better off materially, we do not get any happier. Maybe this is what is happening in the data displayed in Fig. 2.1, which contrasts the growing material well-being of the US with the deteriorating happiness levels. Are we making ourselves miserable trying to outdo our neighbors?

A different conclusion comes from the data in Fig. 2.2, which compares across countries GDP per capita with happiness measured by Ingelhart and Klingemann. It looks as though a little extra income for these poor countries matters a lot. But look again. If you put your hand over all those unhappy Former-Soviet-Union countries with low incomes, what remains looks like a pretty straight line: More income, more happiness.²

¹ Surveys might not work to measure happiness but neuroscience promises to provide “objective” measures. R.J. Davidson finds that positive feelings excited by visual displays create brain activity for right-handers at the left side of the prefrontal cortex and negative feelings in the same place on the right side of the brain. Davidson, R.J. (2000) ‘Affective style, psychopathology and resilience: Brain mechanisms and plasticity’, *American Psychologist*, 55, 1196–1214.

² Incidentally, the horizontal scale in this last figure is not GDP per head but income per head. But double-entry book-keeping assures that production and income are identical. That which is produced and sold generates income for the seller. That which is produced but not sold also generates income for the producer in the form of valuable inventory that can be sold later.

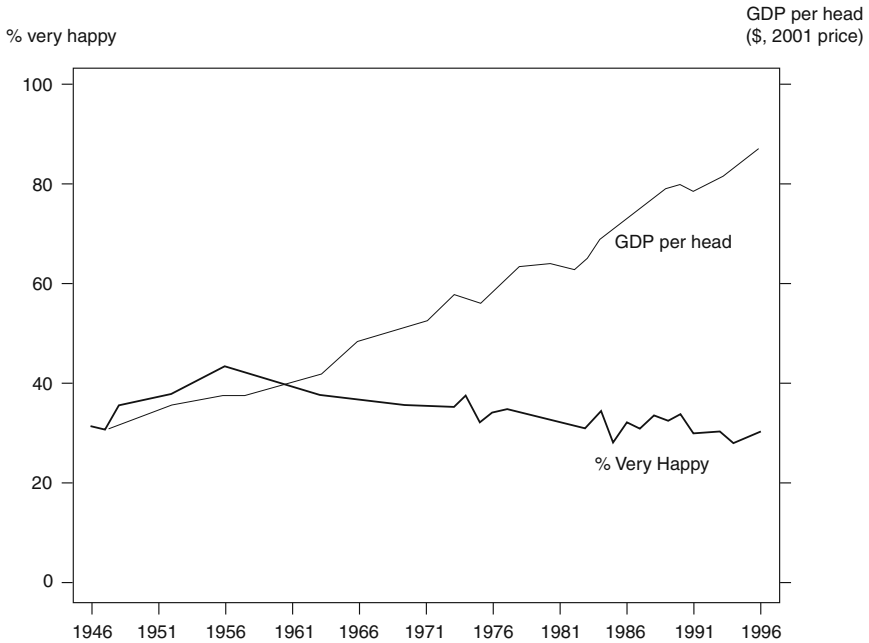


Fig. 2.1 Income and happiness in US

2.1.1.3 GDP Works Fine for us

Though GDP is a problematic measure in many ways, it actually serves our purposes quite well. This book is not about comparing the happiness of California and France. This book is about the business cycle. Every country and every community has periods when GDP is growing nicely, and jobs are plentiful, and also periods when GDP is declining or growing slowly, and jobs are hard to find. These periods of weak or negative growth are called “recessions,” suggesting an organism like a mold that generally grows but every once in a while it recedes a little bit. In the popular press, a recession is defined as “two quarters of negative GDP growth.” This is not a good definition, for reasons I will explain below. But negative GDP growth, like a high body temperature, is a very important symptom of illness. That’s why we are looking at it closely.

2.1.2 What Do Those Three Letters Stand For?

Make sure you understand each letter: G and D and P.

“P” for product, refers to the *production* of goods but also to the production of services. Thus GDP includes both assembling automobiles and giving massages.

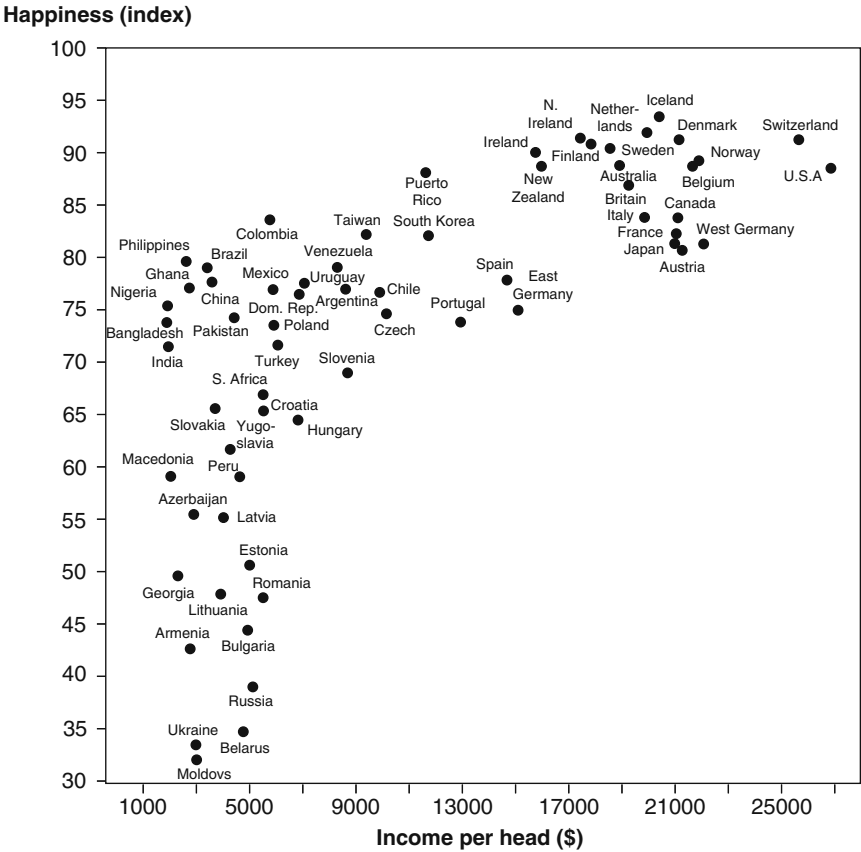


Fig. 2.2 Income and happiness across countries
(Source: Richard Layard, Income and Happiness, Lionel Robbins Lecture, March 2003, <http://cep.lse.ac.uk/events/lectures/layard/RL030303.pdf>)

“D,” for domestic, means “made in the USA.”³ It does not matter whether the factory in South Carolina is owned by Ford or by BMW. The auto is still made in USA. Gross *National* Product, on the other hand, refers to the value of goods and services produced by Americans, no matter where the production takes place. Part of the value of that automobile made in Georgia comes from the BMW brand and that accrues to German owners. That is not included in GNP. Only the part of the value of that BMW automobile that is attributable to US workers is included in US GNP.

Thus the difference between GNP and GDP is whether the country is defined by geography or by ownership. For most countries, GDP and GNP are very similar, and in any case, the concept of GNP is rapidly losing its meaning as corporations become multinational in ownership and as footloose intellectual service workers wander the globe in search of the most lucrative contracts. Just for the record, US

³ Forgive the chauvinism. Search and replace USA with Your Country.

Table 2.1 Relation of gross domestic product, gross national product, net national product, national income, and personal income, 2005

Bureau of economic analysis	\$billion	%	Per capita
Gross domestic product	12,456	100.0%	41,519
Plus: Income receipts from the rest of the world	513	4.1%	1,711
Less: Income payments to the rest of the world	482	3.9%	1,605
Equals: Gross national product	12,488	100.3%	41,626
Less: Consumption of fixed capital	1,605	12.9%	5,349
Private	1,353	10.9%	4,509
Domestic business	1,059	8.5%	3,530
Households and institutions	294	2.4%	978
Government	252	2.0%	841
Equals: Net national product	10,883	87.4%	36,276

GDP in 2005 was \$12.456 trillion while US GNP was \$12.488 trillion. That's too small a difference to worry about. Check it out in Table 2.1.

2.1.3 What's "Gross" About Gross Domestic Product?

What about the "G" in GDP? Whatever is gross about Gross Domestic Product, anyway? (Ask your economist friends. A lot of them don't know the answer.) If not "gross," then what? Pleasant?

To an accountant "gross" means including everything and "net" means something has been removed. There are a lot of things that might be "netted" out of GDP, but for us, Net National Product is the value of goods and services produced, net of *depreciation*.

You know about the depreciation of your car. That \$40,000 new car you bought last year is worth only \$30,000 today. If you have spent all of your earnings this year, your personal wealth has declined by \$10,000 because of this depreciation. Just to tread water, you need to put aside \$10,000 to offset that depreciation. If you don't, your wealth will deteriorate.

Net National Product is the amount of product left over after enough is put aside to offset the depreciation of our equipment and our buildings.

As can be seen in Table 2.1, in 2005, US depreciation (consumption of fixed capital) was \$1605 billion, equal to 12.9% of GNP. That is how much of GNP was needed to maintain and to replace worn-out existing capital. The last column of Table 2.1 has the per capita figure. Notice that household figure of \$978 – that is your home and your car depreciating.

2.1.4 What's "Real" About "Real GDP" and What Is "Nominal" About "Nominal GDP"?

Another word puzzle is to figure out what is the meaning of "Real GDP." What's real about real GDP? And what's the opposite of real? Unreal?

Instead of calling it “unreal” GDP, economists call it “nominal” GDP, meaning “in name only.” There is *real* GDP and *nominal* GDP.

There can be something unreal or “in name only” about increases in the market value of goods and services, since you can pay more but get less if prices rise. “Real GDP” controls for price differences over time and across countries. It measures the real stuff we are producing. “Nominal” GDP is only the money value of the items, which can go up or down depending on the prices.

To get a clear visual image of the difference between “nominal” and “real” GDP, picture yourself checking out of a grocery store. Pile into your shopping basket all the goods and services that are made in US in a given year. That’s “real” GDP. Now go through the checkout line to find out how much these products cost. We need a name for the total cost of the items in your shopping basket. Let’s call that “nominal” GDP to draw a distinction with “real” GDP.

Nominal GDP



Real GDP



Understand that Real GDP changes only when the stuff in the shopping basket changes. But nominal GDP can change either because the stuff is changing or because the prices are changing. If prices are rising, you may have to pay more, even though you do not “really” have more. Thus nominal GDP can increase when real GDP stays fixed.

The visual image of real GDP that you constructed for yourself probably has a great variety of products in your shopping basket. We need to summarize all that detail in a single number. The way this is done is by fixing the prices at some base year, say the year 1996. Value the stuff in your shopping cart at fixed prices that do not change each time you check out of the store. If you use 1996 prices, call that “GDP in constant 1996 prices” or “real GDP” for short. Be sure you understand that changes in GDP in constant 1996 dollars cannot be due to changes in prices. Real GDP can change only if the products in the basket change.

Nominal GDP: GDP is the market value *in current prices* of goods and services produced within the geographic borders of the United States.

Real GDP: Real GDP is the value *in base year prices* of goods and services produced within the geographic borders of the United States.

Remember, when you hear an economist say the word “real,” visualize a basket of real goods rolling through a checkout line at the grocery store. Contrast that with

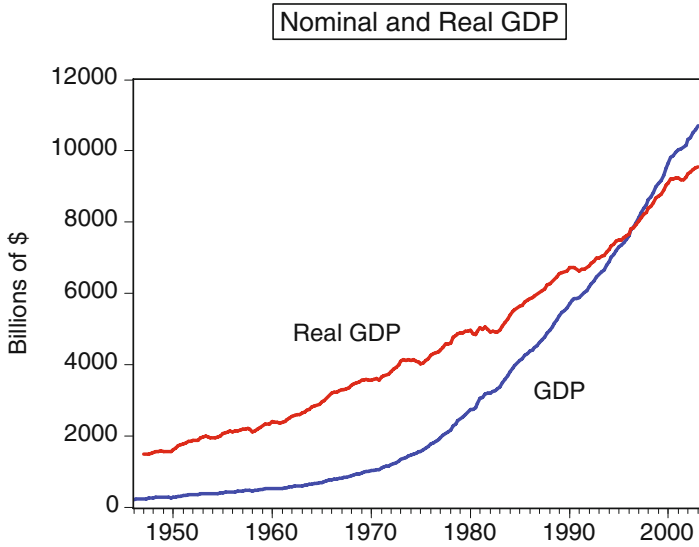


Fig. 2.3 Nominal and real GDP

the money left behind to pay for all that stuff. The money is “nominal” and the goods are “real.”

Real and nominal GDP are displayed in Fig. 2.3. Looking at this figure you should be able to answer the following questions:

Why do Real GDP and Nominal GDP cross in 1996?⁴

Why does Nominal GDP rise more rapidly than Real GDP?⁵

Then two last questions:

Why 1996? Why use 1996 prices as the base year?

As far as I know, that is entirely accidental. This base year changes over time, keeping pretty close to the current year. That makes sense because we want to use prices with which we are most familiar to value GDP. Other than recency, there is not any special reason for the choice of base year.

Does the choice of the base year matter?

This question has two answers: Yes and NO. Start with No first.

Take a look at the chart above that compares real GDP and GDP. These cross at the base year 1996. Suppose that we changed the base year to 1980. Then we have to lower Real GDP down to make it cross the GDP curve in 1980. So the base year seems to matter. But the picture of Real GDP stays exactly the same. It has the same growth rate and the same

⁴ Answer: We are using 1996 prices to evaluate real GDP.

⁵ Answer: Prices have always been rising and accordingly the value of GDP rises more rapidly than the real GDP.

wiggles here and there. So the base year really does not matter at all. Granted, if you use 1980 prices to value production, the values will be less than if you use 1996 prices. But there are no questions that we are going to ask that depend on this difference. So forget it.

But this “no” answer is based on the assumption that relative prices do not change very much. If relative prices do change substantially, the base year does matter for GDP growth calculations. The falling price of computers offers a good example. Let us compare 1980 with 2000. Suppose that your 1980 shopping cart had only two items: an automobile and one personal computer, and suppose that your 2000 shopping cart had the same automobile but *two* personal computers. How much more stuff is there in your 2000 basket. In 1980, the automobile cost \$5000 and the computer cost \$5000. In 2000, the same automobile cost \$20,000 and the same computer only \$1000. Using 1980 prices, you spent \$10,000 in 1980 and \$15,000 in 2000, for a 50% increase in “real GDP.” But using the year 2000 prices, you spent \$21,000 in 1980 and \$22,000 in 2000, for a 5% increase in “real GDP.” So which is it: Did real GDP grow a lot or only a little? For more on this index number problem, see the appendix to this chapter. Believe me, we have much bigger things to worry about than this. We are looking mostly at short-term ups and downs of real GDP in intervals of time in which relative prices do not change enough to cause a big measurement problem. For longer-term issues, like deciding how much cost-of-living adjustment is appropriate for Social Security recipients, this index number problem is a much bigger deal.

2.1.5 What Does SAAR Mean?

If you visit the Web site of the Bureau of Economic Analysis you will discover that the GDP data come both annually and quarterly. Below is an excerpt from a quarterly table with the data for 2002. Notice that the Real GDP numbers on a quarterly basis are each about the same as the annual number \$9,440 billion. How can that be? Should not the amount we produce in a year be about four times what we produce in a quarter? Yes, that is true, but GDP is not how much we produced. Its the *rate* at which we were producing. GDP is the market value of goods and services produced within the geographic borders of the United States *per unit of time*. The BEA alerts us to this by including the acronym SAAR in the table – Seasonally Adjusted at Annual Rates. (Back to seasonal adjustment later.)

Table 1.2. *Real Gross Domestic Product*
[Billions of chained (1996) dollars]
Seasonally adjusted at annual rates

2002			
I	II	II	IV
9,363	9,392	9,485	9,518

Source: <http://www.bea.doc.gov/>

Notice also in this table the reference to chained (1996) dollars. This is the BEA telling us that they have been working hard trying to adjust for changing relative prices as discussed in the appendix below.

2.1.6 What Is an Annualized Compound Rate of Growth?

While we are on this annualization point, we should also discuss “annualized rates of growth.” The BEA estimates of Real GDP in 2001 and 2002 were 9,214.5 and 9,439.9, respectively. The percentage difference between these two numbers is 2.4%. That is the rate of growth in Real GDP *per year*. The BEA estimates of Real GDP in 2002 Q1 and Q2 were 9,363.20 and 9,392.40. The percentage difference between these two numbers is only 0.312%. That is the rate of growth in Real GDP *per quarter of a year*. This is going to get hopelessly confusing unless we standardize on the time interval. In the case of interest rates, a year is the standard time period. When the Wall Street Journal reports that the yield on a 10-year Treasury is 4%, that is not 4% over the whole 10 years, that is 4% per year. We will do the same thing for GDP growth. That is the rate of growth per year.

To transform that growth figure of 0.312% per quarter into an annual number, we could just multiply by four to obtain 1.247%. But the annualized rate of growth is just a little bit greater than that because of the effect of compounding. After four quarters of growth at the rate of 0.312% per quarter, the increase in the GDP is actually 1.253%. That is the annualized compound rate of growth.⁶

2.2 What Does Real GDP Look Like?

2.2.1 Does a Logarithmic Scale Help? The Narrow Corridor of US GDP Growth

Real GDP is displayed again in Fig. 2.4. Look at that scale – the distance between 2 and 4 trillion is the same as the distance between 4 and 8. That is a logarithmic scale. In a logarithmic scale, a straight line represents a constant rate of growth. The two straight lines drawn in this figure identify the narrow corridor in which real GDP has been confined since 1970. The floor and ceiling of this corridor grow at the rate of 3% per year and the distance from floor to ceiling is $\pm 3\%$. Call that the 3–3 rule of US GDP. Notice that the US grew a bit faster than this 3% rate in the 1960s.

You can also see in this figure the periods when GDP was dipping down to the floor of the corridor and when it zoomed back up to the ceiling. The dips downward

⁶ The formula for computing the growth rate with quarterly data is:

$$\text{Annualized compound rate of growth per year} = -1 + (\text{RGDP}/\text{RGDP}(-1))^4,$$

where RGDP refers to the Real GDP and RGDP(-1) to RGDP in the previous quarter.

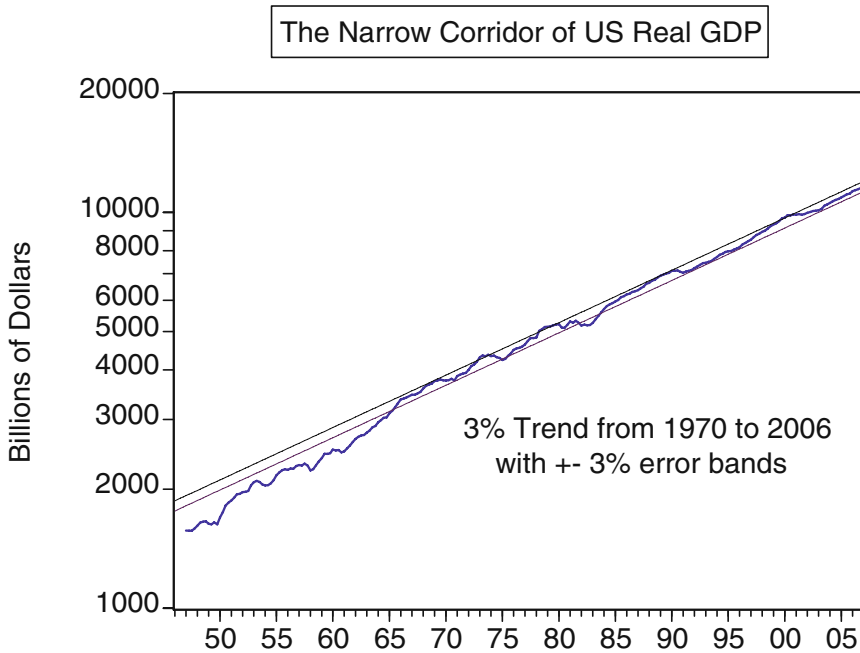


Fig. 2.4 Real GDP grows in a very narrow corridor

are the “recessions.” These are followed by “recoveries” when GDP rises above the floor of the corridor.

This figure gives us our assignment. We need to understand why the US GDP has been growing at a 3% rate for 30 years and we need to form an opinion whether or not this is going to continue for the next 30. We need to understand why the GDP occasionally dips down to the floor of the corridor and sometimes rises above the ceiling. We need to know when the next dip is going to occur.

Parenthetically, after Ronald Reagan’s death I received an e-mail proclaiming that the Reagan tax cuts had “unleashed a juggernaut of economic growth.” Look again at Fig. 2.4 to find that juggernaut of growth. Can you see it? I see the US economy growing persistently at 3%. We had the oil shocks of the 1970s, and still 3%. In the early 1980s, we had the Reagan tax cuts and the subsequent deficit, and still 3%. In the mid-1980s, we had the overvaluation of the dollar and the subsequent depreciation, and still 3%. We had the Internet Rush in the 1990s, the Bush W. Tax Cuts, the Bush W. Deficits, and the Housing Bubble in the 2000s, and still 3%.

If you think this book focuses a lot on recessions and recoveries, the preceding paragraph tells why. It is the ups and downs within the corridor of growth that call out for explanation and control. The remarkable persistence of the long-term rate of growth leaves the clear impression that the long-term trend is just something we

have to live with. That long-term growth rate surely cannot depend much on tax rates or interest rates, at least not given the historical variability of these two policy instruments. All bets are off if we had income taxes at 90% or interest rates and inflation at 20%. But within the historical range, Fig. 2.4 suggests that fiscal and monetary policy should be focusing on something they have some hope of influencing: not the long-term trend but the descents that cause distress, and the ascents that lay the foundation for the next descents. That’s why we are focusing a lot on recessions and recoveries.

2.2.2 Four Pictures: What Does Growth of Real GDP Look Like?

Remember a theme of this book: pictures, words, and numbers. A persuasive argument requires well-chosen pictures, well-chosen words, and well-chosen numbers. Concentrate on the pictures and words. People do not understand numbers.

We already have learned a lot from Fig. 2.4 and the words that have accompanied it. There are some *other* good pictures of GDP worth looking at. Figure 2.5 is a bar chart that displays the GDP growth rate, quarter by quarter. Figure 2.6 is a moving average of the same data. And Fig. 2.7 illustrates one measure of the volatility of

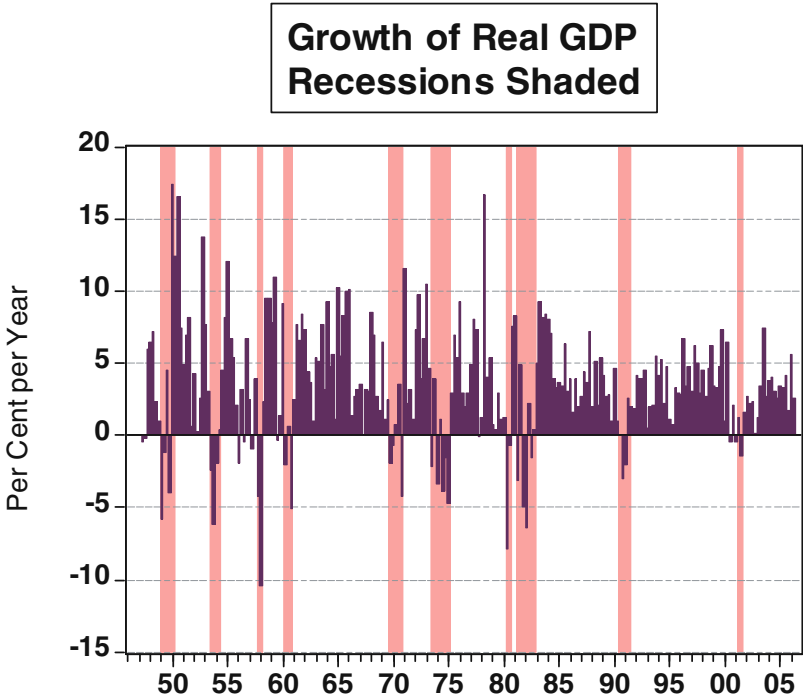


Fig. 2.5 Quarterly GDP growth, SAAR: recessions shaded

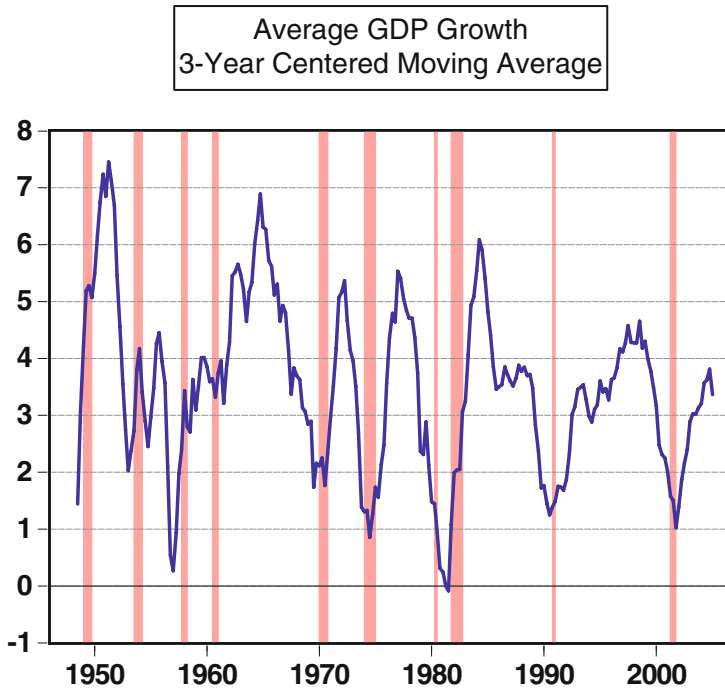


Fig. 2.6 Moving average GDP growth, recessions shaded

GDP growth. Which display is best? Which communicates an important message most clearly?

While the first display, Fig. 2.4, is a good one for depicting long-term movements in GDP, the growth bar chart, Fig. 2.5, concentrates the eye on the quarter-by-quarter differences. Here you can see the 10 recessions very clearly as the periods in which the growth bars dangle downward. Remember that it is only a panel of economists at the National Bureau of Economic Research who have the official function of selecting the quarters in which the economy was in recession. Feel free to question their judgments. Were there really two separate back-to-back recessions in early 1980s? Did they miss the onset of the 2001 recession by a quarter?

The recessions jump out at you from the bar chart Fig. 2.5, but what else can you see? Can you see the rather high volatility of GDP growth from quarter to quarter? This should alert you to the fact that knowing GDP growth in one quarter cannot tell you much about GDP growth the next quarter. We will come back to this later. Also take a look at growth in the Kennedy/Johnson expansion in the 1960s compared with the Bush/Clinton expansion of the 1990s. What differences do you notice? There are two. The Kennedy/Johnson bars are both generally higher and also more volatile. We already learned from the first display, Fig. 2.4, that growth was greater before 1970 than after, so that's not news, and this fact is much more clear in the first display than the second. But that first long-run display does not tell

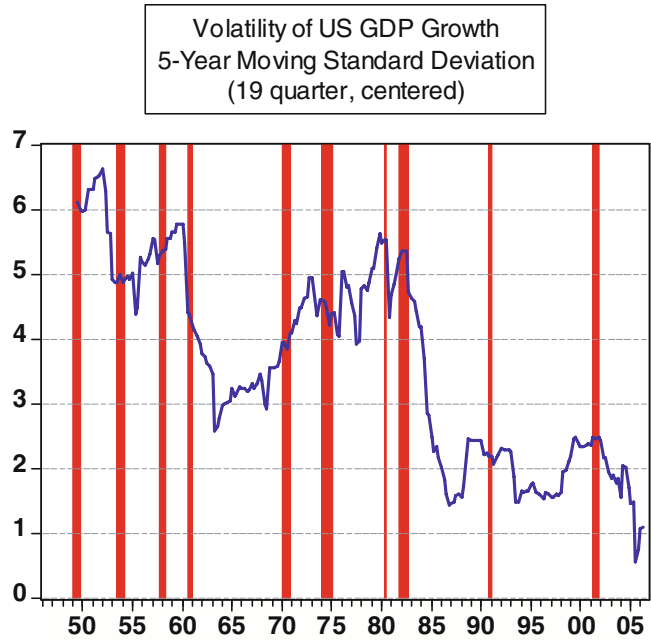


Fig. 2.7 Volatility of GDP growth

us anything about the quarter-to-quarter variability. If you look real close you can see the recessions in the long-term display Fig. 2.4, but the bar chart Fig. 2.5 makes the recessions very apparent.

A problem with the growth bar chart, Fig. 2.5, is that GDP is very wiggly. All those wiggles can be pretty distracting. The long-term display, Fig. 2.4, goes too far in eliminating almost all the wiggles. A good way to eliminate much of the variability but to retain some as well is to display a moving average of GDP growth. A three quarter centered moving average is the average of the current, preceding, and following quarter's growth number:

$$\text{Moving Average} = (\text{Growth}(-1) + \text{Growth} + \text{Growth}(+1))/3$$

Figure 2.6 illustrates a 3-year (11 quarter) centered moving average of GDP growth. Here the magnitude of the difference between the 1960s and the 1990s is clear (one or two percentage points), while the long-term display in Fig. 2.4 tells us nothing of the magnitude. If you need to know the magnitude, the choice of picture is obvious.

Next, what about volatility? If you look hard at the corridor of growth, Fig. 2.4, you can see that the US economy was more prone to be at the edges of the corridor in the 1970s than the 1990s. That's because the more recent recessions have been much less severe, a point that is apparent in the dangling down bars in Fig. 2.5. It

is very interesting that the smoothed growth rates in Fig. 2.6 tell a different story. The dips in the 1970s were about as deep as the dips in the 1990s but pulling the three-year averages down to about 1.5% per year. It was the double-dip recession of the early 1980s that really knocked down the three-year average growth.

Homework problem: Explain why Fig. 2.5 suggests that recessions are getting milder but Fig. 2.6 suggests there has been little change (or disagree with this conclusion.)

To do better on volatility, we need a numerical measure of volatility. I suggest the standard deviation. The standard deviation is a measure of dispersion of a group of numbers. If the numbers form a bell-shaped normal distribution, then 67% of the numbers are within one standard deviation of the mean, while 95% are within two standard deviations. That is all we need to know for now.

Figure 2.7 illustrates the standard deviation of the GDP growth numbers taken 5 years at a time, rolling that 5-year window over the data. Here you can see the sharp drop in volatility in the early 1980s, but there was a similar drop in the early 1960s.

This decline in volatility is potentially important for business decision-making and for forecasting. Can we expect this stability to continue, or get even better? This matters a lot for inventory policies. Lean inventories and low ratios of inventories to sales work fine in a stable economy, but not well in a volatile one. New Economy advocates in the mid 1990s were promising steady growth forever and indeed there was a significant decline in volatility, which can be seen in Fig. 2.7. But for Cisco in 1999, inventories that were planned to be “just-in-time” turned out “way too early” when sales of routers and servers dropped dramatically and inventories built up.

GDP volatility bumped up again with the onset of the recession of 2001, but subsequently volatility has fallen to an all-time low standard deviation of 1.0. How small is that standard deviation of 1.0? If GDP growth is approximately normal with a mean of 3 and a standard deviation of 2, there is a 7% chance of a negative, but with a mean of 3 and a standard deviation of only 1, the chances of a negative are only about 0.1% (1 in a 1000). Are recessions a thing of the past? We need to answer this important question.

Now I ask you to stop looking at these four graphs, and try to remember each of them.

- Which picture is the most memorable?
 - You will want to include that one in any presentation

Now you can look at them again and answer two more questions:

- Which picture conveys most clearly the most amount of information?
 - You may want to include that one as well since you will be there to explain it.
- Which picture conveys information not conveyed by any other picture?
 - If it important to make this point, you will need to include this display.

Make a note of this important point: There are many ways to display the same data, and each can send a different message. *Work hard to find a display that sends the message you intend.*

2.2.3 How Much Is \$10 Trillion? Does Dividing by Employment Help?

US GDP is currently about \$10 trillion. You really have no idea how much is \$10 trillion, do you? It is just a number with a bunch of zeroes. *A number has meaning only when we can compare it with something familiar. If you are going to use numbers to persuade, be sure that your audience has a basis for comparison.* Dividing GDP by the number of workers does the trick quite nicely. That \$10 Trillion translates into \$70,000 per worker. Now you have a scale of reference. Compare your annual earnings with \$70,000. How are you doing? Are you producing more than the average worker?

Real GDP per worker is displayed in Fig. 2.8, again with a logarithmic scale. Back in the early 1950s, it was only \$30,000 per worker. Now it is \$70,000. We are producing more than twice as much per worker as we did a half-century ago! Figure 2.8 conveys a very different message than the constant rate of growth of Real GDP equal to 3.45% illustrated in Fig. 2.4. Here, in Fig. 2.8, we have a high growth of Real GDP per worker until about 1970s, then slow growth between 1970 and 1980, then what looks like a new trend line after 1980. This is an extremely important fact for thinking about the future.

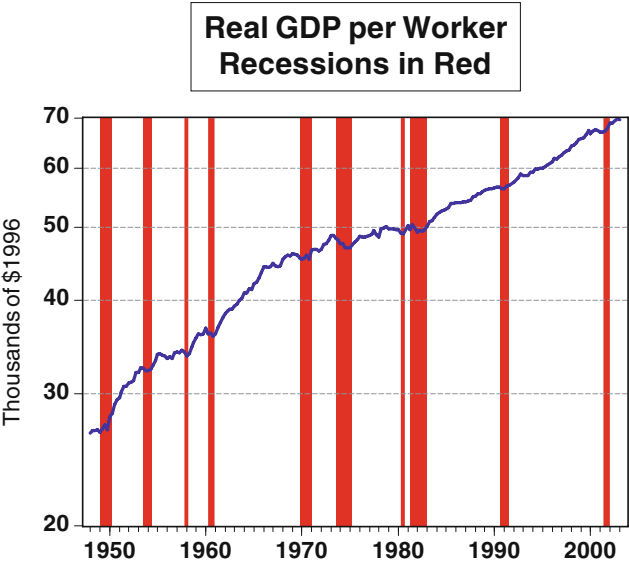


Fig. 2.8 Real GDP per worker

Appendix: The Index Number Problem and Chain Indexes

Suppose that you checked out of a grocery store in January 2000 with \$100 worth of groceries. If a year later in 2001 you check out with \$117 worth of merchandise, did you get more stuff? Was your shopping basket more full? Not necessarily. Maybe you have the same stuff, and it just cost more a year later. How are we going to figure out if you have more stuff in 2001? Specifically, consider the following details about prices and volumes in the 2000 and 2001 baskets:

Shopping Baskets in 2000 and 2001						
	2000			2001		
	Number	Price	Value	Number	Price	Value
Apples	60	1	60	45	1.4	63
Oranges	40	1	40	60	0.9	54
Total			100			117

In 2000, you bought 60 apples and 40 oranges, each at the price of \$1. In 2001, the price of apples rose quite a bit and the price of oranges fell. You wisely decided to buy more oranges but fewer apples. You spent more in 2001, but I am not so sure if you bought more. Sure, you have more oranges but you also have fewer apples. How can we compare apples to oranges? I am not so sure but I have an idea. I can compute what it would cost to buy those goods in 2001 if the prices were the same as 2000. That is using constant prices to value the basket. That is a good way to compute the real value of the goods, and that is exactly how real GDP is computed. The problem with the calculation is it depends on which prices you select. If you use 2001 prices it may look like there is more stuff in the basket in 2001, but if you use 2000 prices it may appear to be the opposite. Indeed, that is what happens here:

Values in “Constant Dollars”				
	\$2000		\$2001	
	2000	2001	2000	2001
Apples	60	45	84	63
Oranges	40	60	36	54
Total	100	105	120	117
Change		5%		−3%

First use the year 2000 prices to value the baskets. Those 45 apples and 60 oranges that you bought in 2001 would have cost \$105 in 2000, compared with only \$100 for the 60 apples and 40 oranges in 2000. Thus you have 5% more “stuff” in your basket in 2001. Next do the same calculation with year 2001 prices. Those 60 apples and 40 oranges that you bought in 2001 would have cost \$120 in 2000. That compares with the \$117 value of what you bought in 2001. Thus you have 3% less in your basket in 2001. So which is it? Is the 2001 basket fuller than the 2002 basket, or the other way around??

Boy that seems alarming. Never mind. It is a cooked up example with wild swings in prices and quantities. Real movements in prices and quantities make the choice

of base year a whole lot less important, and in any case government statisticians work hard devising “chained” or compromise measures. The “chain” compromise between the 5% increase in the basket using intial prices and the -3% reduction using final prices is found by multiplying the two and taking the square root: $1 - ((1 + .05) * (1 - .03))^{1/2} = 0.9\%$. Forty five apples and 60 oranges is 0.9% “more” than 60 applies and 40 oranges.

This chain compromise makes the problem even less. Especially for our purpose of finding out if the US economy is in recession or not, this measurement issue is virtually irrelevant.

Appendix: The Seasonal in GDP Is Very Large

We need to take a look at the seasonal patterns of GDP growth since they tell an alarming story. The annualized rates of growth of GDP (nominal not real) from 1946 to 2001 are displayed separately for each quarter in Fig. 2.9. There are dramatic

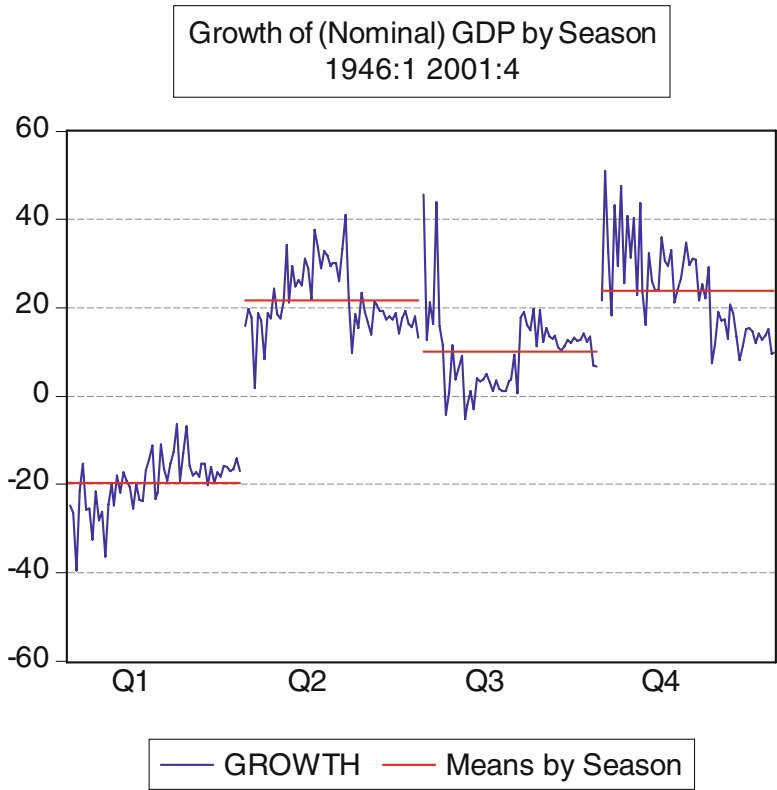


Fig. 2.9 Seasonal patterns of nominal GDP growth

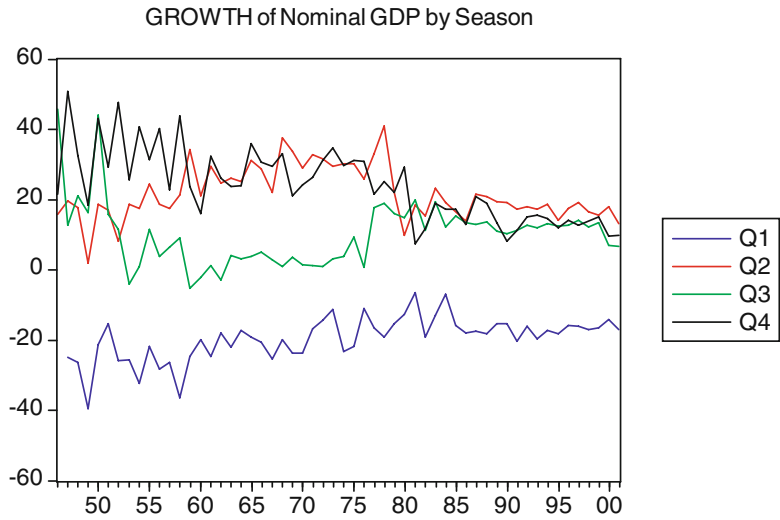


Fig. 2.10 Growth of nominal by season

differences among the quarters! Though on average, nominal GDP has grown at the rate of 9.2%, the January–March first-quarter production has been down compared with the fourth quarter at the annualized rate of about -20% ! After working so hard to get those gifts ready for the holiday, Santa and his elves huddle around

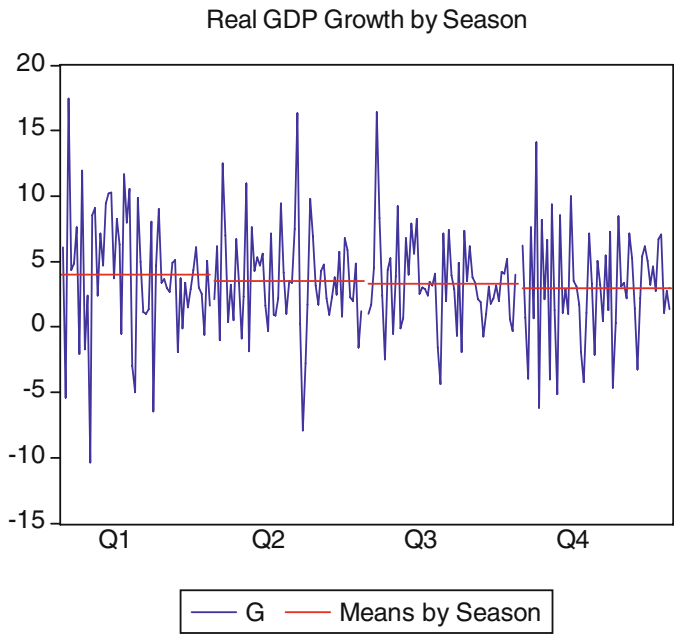


Fig. 2.11 SAAR Real GDP growth by season

the fireplaces in the winter and do not get much done. But the springtime brings a renewal and a complete return to normal, providing a +22% rate of growth. The summer offers normal growth (10%) compared with the Spring, and then that last quarter is when we get the most growth, averaging 24% compared with the Fall.

Note the apparent change in the seasonal pattern over time. You can see this best in Fig. 2.10. The seasonal pattern stabilizes after 1980 with only a first quarter effect, and an effect that is relatively mild. From 1960 to 1980, we had strong fourth and second quarter growth, little growth in the third and a large negative in the first. Before 1960, the fourth quarter was exceptionally strong. I am wondering how the Department of Commerce does their seasonal adjustment. I hope they are not using that old data.

Don't worry. If the Commerce Department were not aware of the changing seasonal, then their seasonally adjusted data would have one seasonal pattern for part of the data and an offsetting pattern for the rest. That isn't the case, as you can see in Fig. 2.11.



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