

In this segment of the project, you will use the *IS/TR*, *AD/AS*, and Phillips curve models to analyze the business-cycle fluctuations in your country over a period extending back (if possible) to the mid-1970s. You should recognize from the outset that these models are just models and that they will not explain every movement in your data precisely. Look for broad outlines or patterns rather than trying to track every year-to-year movement in every macroeconomic variable. You may perform your analysis using quarterly or annual data. The quarterly data will give you a finer temporal analysis, but may also lead to some problems because there are likely to be lagged relationships.

The major endogenous variables you should examine are real GDP (relative to trend), inflation, the unemployment rate, exchange rates, and interest rates (real and nominal). Exogenous shocks can come from monetary and fiscal policy changes, changes in economic conditions in the economies of other countries that are trading partners, shocks to world commodity prices (such as oil), or changes in other domestic variables such as “optimism,” real wealth (through the stock market or housing prices, for example), laws or regulations, etc.

Your analysis should use the tools that we have developed for analyzing the relationships among these variables: the *IS/TR* model for short-run aggregate demand changes, the *AD/AS* for short-run and long-run changes in the output gap and inflation, the Phillips curve to relate unemployment and inflation in the short run and long run, and the open-economy variants of these models when appropriate.

However, your analysis must not just be a set of graphs with short descriptions; it should be a narrative essay that is *informed* by the models (with graphs) where they are useful. Your report should be a paper in which the story of the business-cycle fluctuations in your country is told with words, supplemented (when useful) by graphs.

Do not attempt to track every year of your sample in every diagram. For each relevant period (perhaps 5–10 years in length) within your available sample of data, tell a story about what happened to the important endogenous variables and what changes in exogenous variables might have caused these changes, using both theoretical graphs (such as *IS* and *TR* curves) and historical data graphs (time plots or scatter plots of one variable against another) to illustrate your narrative.

You may well find anomalies that don't fit with the theoretical predictions of the models. Discuss these in detail and try to assess why the model does seem to fit. Is there something

else changing at that time that could be moving the curves around to produce the results that you see? Is there something about your country that would make the curves behave differently? (For example, does the monetary-policy authority not follow a Taylor Rule?)

This analysis is less “directed” than the earlier segments. There are no specific assigned tasks, but there are a few things that you should do to support your analysis.

- You will definitely need to calculate a trend series for $\ln(\text{GDP})$ and a corresponding “GDP gap” series as the deviations from the trend. Instructions on how to do this in Excel are in Appendix A below. Once you get your trend series, subtract the $\ln(\text{GDP})$ series from the trend series (and multiply by 100 if you want to put the series in percentage form) to calculate the GDP gap. Plot the gap series over time to make sure it makes sense. It should not be above or below zero for extended periods of time (more than 5-6 years); if it is, you probably need to estimate separate trends for two or three sub-samples within your data. An example is shown in Appendix B using U.S. data.
- It would make sense to plot the unemployment/inflation relationship for your entire working sample and for appropriate sub-samples, as in the textbook’s Figure 12.10. This is a “scatter” graph in Excel that can be created easily by putting the time series for the unemployment rate and inflation rate next to each other in a spreadsheet. Unfortunately, there does not seem to be an easy way to label the data points with years in Excel. Ryland Bell has found an “add-in” to Excel that will do this and works well for me. It is described in Appendix C; try it if you want.
- It would also be useful to plot the output gap against inflation in the same way, giving a visual representation of the short-run AS/AD movements. You might also plot the output gap against the nominal interest rate to see what might be happening in IS/TR space. Any or all of these might be broken into sub-samples if that makes the pictures more coherent.

Appendix A: How to create trend and GDP gap series in Excel

In your growth analysis, some students found that the trend path changed (either in level or slope) at certain points in the sample. If you have an unstable trend, estimate the trend separately for two or perhaps three sub-samples of length 8 or more years. Do not try to track cyclical movements with your trend by estimating trend on sub-samples of only a few years. But, for example, if growth was slower after 1973, do not use a single trend across the two sub-periods with different growth rates. Doing so can give you nonsense, as shown in the next appendix.

To calculate the trend and gap series, start with a series for the natural log of real GDP (lrgdp in the earlier assignment). The example below uses a very short sample (so that the

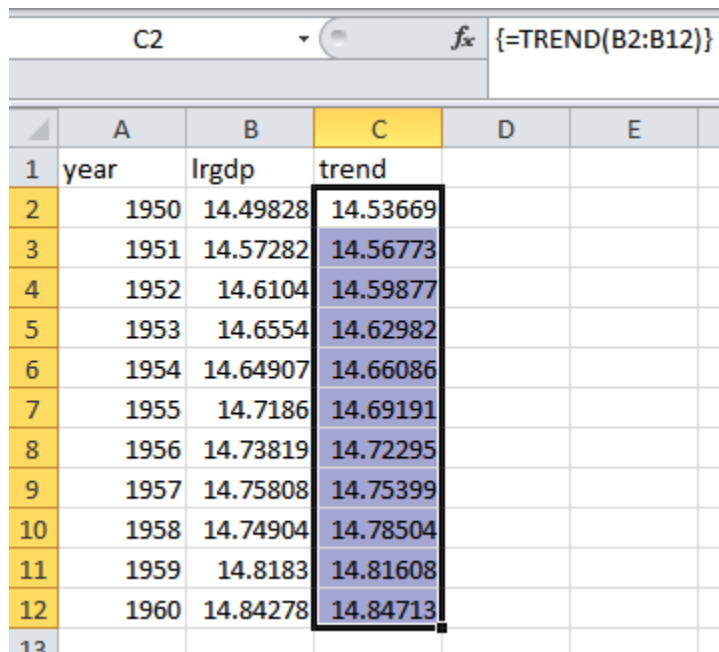
illustrations are compact) for the United States (1950–60) to illustrate the process. To start the analysis, your data should look something like this:

	A	B	C
1	year	lrgdp	
2	1950	14.49828	
3	1951	14.57282	
4	1952	14.6104	
5	1953	14.6554	
6	1954	14.64907	
7	1955	14.7186	
8	1956	14.73819	
9	1957	14.75808	
10	1958	14.74904	
11	1959	14.8183	
12	1960	14.84278	

We will create a trend series for lrgdp in column C using an Excel “array formula.” First, select the entire set of cells where you want the trend series to go, presumably they are next to your lrgdp series (C2:C12). Then, with all of these cells selected, type into the box “=TREND(B2:B12)” substituting for B2:B12 whatever range of cells contain the sample of lrgdp observations over which you want to calculate the trend. At this point, your sheet should look something like this:

	A	B	C	D	E
1	year	lrgdp	trend		
2	1950	14.49828	=TREND(B		
3	1951	14.57282			
4	1952	14.6104			
5	1953	14.6554			
6	1954	14.64907			
7	1955	14.7186			
8	1956	14.73819			
9	1957	14.75808			
10	1958	14.74904			
11	1959	14.8183			
12	1960	14.84278			
13					

To make this an array formula that will fill the entire C2:C12 range rather than an individual cell function, *hit Ctrl-Shift-Enter instead of Enter after typing the TREND function*. After you do this, your sheet should look something like this:



	A	B	C	D	E
1	year	lrgdp	trend		
2	1950	14.49828	14.53669		
3	1951	14.57282	14.56773		
4	1952	14.6104	14.59877		
5	1953	14.6554	14.62982		
6	1954	14.64907	14.66086		
7	1955	14.7186	14.69191		
8	1956	14.73819	14.72295		
9	1957	14.75808	14.75399		
10	1958	14.74904	14.78504		
11	1959	14.8183	14.81608		
12	1960	14.84278	14.84713		
13					

Notice that the target cells are still selected. Notice also that the formula in the top line has {braces} around it. This identifies it as an array formula and means that you have done your trend correctly.

The next step is to compute the GDP gap variable in column D by subtracting lrgdp from the trend. I'm also going to multiply by 100 because I find it easier to think of the gap in terms of percentages rather than as a fraction. This does not have to be an array formula, so I can hit Enter (rather than Ctrl-Shift-Enter) after typing " $=100*(B2-C2)$ " into cell D2:

TREND					
				=100*(B2-C2)	
	A	B	C	D	E
1	year	lrgdp	trend	GDP gap	
2	1950	14.49828	14.53669	=100*(B2-C2)	
3	1951	14.57282	14.56773		
4	1952	14.6104	14.59877		
5	1953	14.6554	14.62982		
6	1954	14.64907	14.66086		
7	1955	14.7186	14.69191		
8	1956	14.73819	14.72295		
9	1957	14.75808	14.75399		
10	1958	14.74904	14.78504		
11	1959	14.8183	14.81608		
12	1960	14.84278	14.84713		
13					

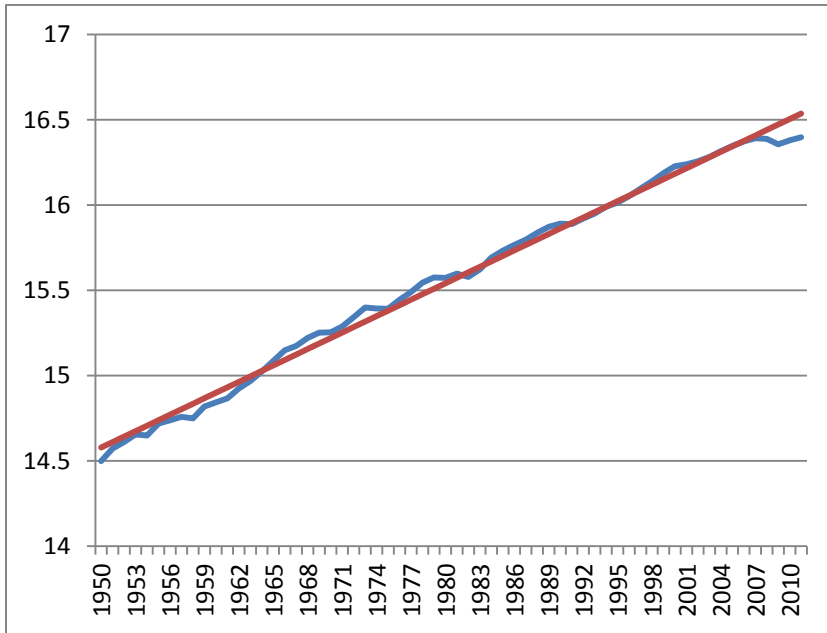
Then I copy cell D2 down to the cells below it in column D, and I have my GDP gap series:

	A	B	C	D	E
1	year	lrgdp	trend	GDP gap	
2	1950	14.49828	14.53669	-3.84086	
3	1951	14.57282	14.56773	0.508678	
4	1952	14.6104	14.59877	1.162718	
5	1953	14.6554	14.62982	2.558571	
6	1954	14.64907	14.66086	-1.17889	
7	1955	14.7186	14.69191	2.669788	
8	1956	14.73819	14.72295	1.52354	
9	1957	14.75808	14.75399	0.408963	
10	1958	14.74904	14.78504	-3.59992	
11	1959	14.8183	14.81608	0.221914	
12	1960	14.84278	14.84713	-0.43451	
13					

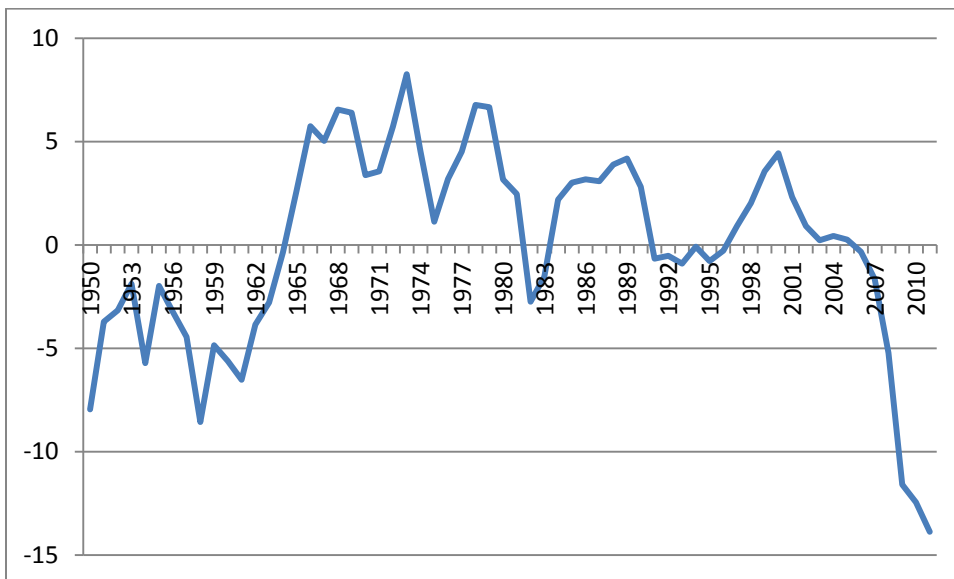
Note that the GDP gap series has both positive and negative values and does not have long runs of large positive values or large negative values. This is what we expect from business cycles: they don't last more than a few years in either a positive or negative direction.

Appendix B: An example of a poorly chosen trend series resulting in misleading GDP gap values

There is a lot of evidence, which we have discussed, suggesting that the U.S. growth trend slowed after 1973. To see how you can get a nonsensical GDP gap variable if you miss breaks in the economy's long-run growth trend, consider what happens if I do a single trend for the United States for 1950 to 2011. The trend looks like this:

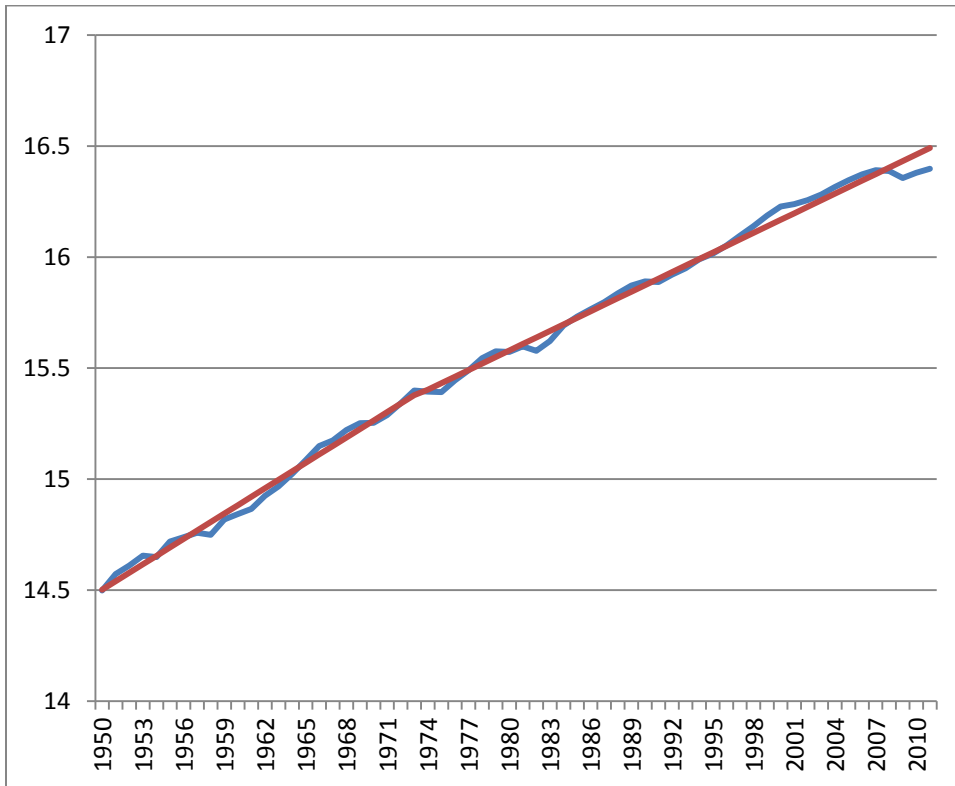


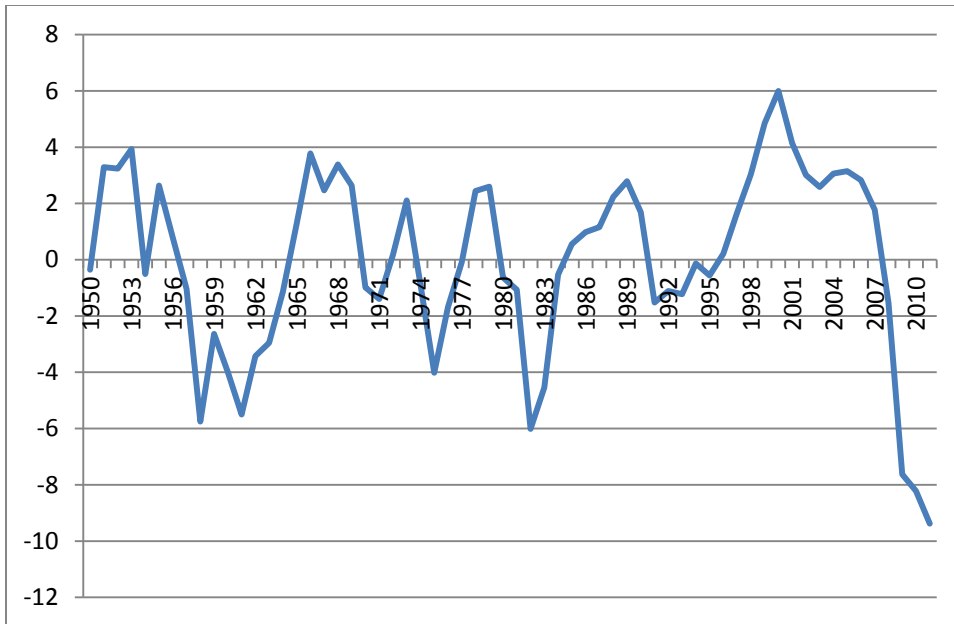
When we compute the corresponding gap variable, it looks like this:



This series claims that the U.S. had a severe recession that lasted from 1950 to 1963—it didn't. The calculated series suggests that there was a boom above trend that lasted from 1965 to 1980—again, this is not reasonable. The presence of these long periods (ten years or more in this case) during which the estimated gap was more than a couple of percent above or below zero are an indication that we have probably not got the trend right.

Suspecting that the U.S. growth trend changed after 1973, we can calculate the trend separately for 1950–73 and 1974–2011. This gives us the following trend and gap series:





This gap series is much more believable. The major cyclical fluctuations (where the gap is more than about 2% in either direction) are few and short. The “Volcker recession” that we talked about in class shows up clearly in the early 1980s, as do the oil shock in 1974–75 and the recent “Great Recession.”

“Correct” identification of trend and gap series is an art; there is no definitive “right” answer. If your cyclical movements in the gap series correspond to the historical narrative of fluctuations in your economy that you found when you researched its history, you are probably on the right track.

Appendix C: An add-in to put year labels into a scatter graph in Excel

Ryland has found an Excel add-in that can be used to put year labels onto an Excel scatter diagram. To use it, follow these instructions:

1. Download the file linked at <http://appspro.com/Utilities/ChartLabeler.htm>
2. With your spreadsheet open, double-click the downloaded file (XYChartLabelerMac.xla) in Finder
3. Choose "Enable Macros" in the dialog box that appears.
4. Select the chart that needs labels.
5. Click the Tools pull-down menu at the top of the page, then XY Chart Labels, then Add Chart Labels.
6. Select the appropriate cells to use as labels (in this case, the cells containing years), and choose a position for the labels (above, below, etc.)

7. If some of the labels are difficult to read, choosing Tools->XY Chart Labels->Move Labels allows you to move the labels in any direction, either all together or individually.

There is a Windows version (with slightly different instructions) at the same site. Using the Windows version, I created the following diagram for U.S. unemployment and inflation from 1976 to 1989:

