

Week 3 Answer Key

Problem 2.16: Using the post-World War II data and the rule of thumb, the recessions in the U.S. economy are as follows:

1948:4-1949:2, 1953:2-1954:1, 1957:3-1958:1, 1969:3-1970:1, 1974:2-1975:1,
1980:1-1980:3, 1981:3-1982:1, 1990:3-1991:1, 2008:2-2009:2

There is a two quarter-fall at the very beginning of the data, but it is hard to date a recession, since we do not know what occurred before that.

A case can be made for two alterations to this dating scheme (students might argue for others: First, the trough of the first recession might be placed at 1949:4 instead of 1949:2. Here are the changes in real GDP around that period:

1948:4	+ 2.2
1949:1	-27.8
1949:2	- 6.7
1949:3	+22.0
1949:4	-18.1
1950:1	+79.9

Although real GDP rises in 1949:3, the rise is smaller than the cumulated fall of the preceding two quarters and is followed by a large fall, so that the net movement from 1948:4 to 1949:4 is a large and clear fall. It is only with the large rise in 1950:1 that unequivocal upward growth resumes. I would thus, replace 1948:4-1949:2 with 1948:4-1949:4. A similar case can be made to add a recession starting in 1960:1. The changes in real GDP around that date are:

1960:1	+68.1
1960:2	-11.9
1960:3	+ 7.7
1960:4	-37.8
1961:1	+21.0

The brief uptick in 1960:3 is overwhelmed by the downticks in 1960:2 and 1960:4, leading me to place a recession in 1960:1-1960:4. Thus the modified list of recessions is:

1948:4-1949:4, 1953:2-1954:1, 1957:3-1958:1, 1960:1-1960:4, 1969:3-1970:1, 1974:2-1975:1, 1980:1-1980:3, 1981:3-1982:1, 1990:2-1991:1, 2008:2-2009:2

Problem 4.1:

(a) Laspeyres: $p_{2010}^L = 100$; $p_{2011}^L = \frac{20 \times 1.00 + 20 \times 0.75}{20 \times 0.75 + 20 \times 0.50} \times 100 = 140$.

Paasche: $p_{2010}^P = 100$; $p_{2011}^P = \frac{30 \times 1.00 + 18 \times 0.75}{30 \times 0.75 + 18 \times 0.50} \times 100 = 138$.

Fisher-ideal: $p_{2010}^P = 100$; $p_{2011}^F = \sqrt{140 \times 138} = 139$.

(b) Chain-weighted index = Fisher-ideal index when there are only two years. Real GDP for 2010 = nominal GDP when 2010 is the base year. Thus, $Y_{2010} = 20 \times 0.75 + 20 \times 0.50 = 25$

and $Y_{2011} = (30 \times 1.00 + 18 \times 0.75) \frac{100}{139} = 31.29$.

(c) $Y_{2010} = (20 \times 0.75 + 20 \times 0.50) \frac{139}{100} = 34.75$. Real GDP for 2011 = nominal GDP when 2011 is the base year. Thus, $Y_{2011} = 30 \times 1.00 + 18 \times 0.75 = 43.50$ and

Problem 4.6:

(a) The Laspeyres index for 2010 is 102.0.

(b) The CPI in 2010 in 1982-84 dollars should be $180.9 \times (102.0/100) = 184.5$.

(c) The value of the CPI in 2002 with 1967 as the reference year $541.9 \times (102.0/100) = 552.7$?

(d) Paasche index for 2010 = 102.1; the chain index = 102.0 [Note: the chain index and the Laspeyres index do differ, but only in the second decimal place]. In the text we argued that the Paasche index would be lower than the Laspeyres index. That is not true here. The reason why can be seen from calculating the rates of inflation for individual goods. Normally, we would expect demand to shift from the goods with the increasing relative prices to those with decreasing relative prices. But that does not always happen – for example if tastes change. Here, for example, food and beverages have the second fastest rate of price increase, and their share falls as expected. However, medical care has the fastest rate of price increase, yet its share rises rather than falls, most likely because changing demographics – especially an older population – has shifted tastes toward more medical care independent of the change in relative prices.

Problem 4.7: No answer provided as it is discussed in detail in the text.

Problem 4.8: The general method of conversion is ${}_{2011}P_t = {}_tP_t \frac{P_{2011}^{CPI-U}}{P_t^{CPI-U}}$. The price level in the target year is ${}_{2011}P_t = 227.1$.

	Price Actual Year	CPI Actual Year (November)	Price 2011:11
(i) Men's Sport Coat 11/60	22.85	29.8	174.13
(ii) Coffee 11/65	1.09	31.8	7.78
(iii) Ford Galaxie 11/72	3,939.00	42.4	21,097.80
(iv) Reclining Chair 11/81	299.00	93.8	723.91
(v) Washing Machine 11/88	604.00	120.3	1,140.22

Problem 4.9: The general rule for conversion is ${}_t P_t = {}_{19983} P_t \frac{P_t^{GDP\ deflator}}{P_{19983}^{GDP\ deflator}}$, where $t = 1948:1$ or

1980:4. Note the relevant price indices are 1948:1 = 13.4, 1980:4 = 46.0, and 1998:3 = 79.0.

For example, for (i) in 1948:1: ${}_{19481} P_t = {}_{19983} 169 \frac{P_{19481}^{GDP\ deflator}}{P_{19983}^{GDP\ deflator}} = {}_{19983} 169 \frac{13.4}{79.0} = 28.67$. Using

the same method:

	Price 1998:3	Price 1948:1	Price 1980:4
(i) Vacuum Cleaner	169.00	28.67	98.40
(ii) Cookware Set	299.99	50.88	174.68
(iii) Man's Sportshirt	24.99	4.24	14.55
(iv) Television	219.99	37.31	128.09
(v) Personal Computer	604.00	102.45	351.70

Problem 5.1:

Note that the recession period from the NBER below is defined as the period from the quarter at the peak to the quarter at the trough (for example, if the peak is in January and the trough is in July of the same year, the recession is from the first to the third quarter of that year). Table 5.1.1 compares the NBER recession dates with the dates from the two-quarter rule as in Problem 2.16. (Note that these are the the pure rule-of-thumb dates and not those modified by any other considerations.) Differences may occur because the NBER does not follow the “rule of thumb” as we used in problem 2.16. Rather the NBER identifies recession using i) depth as well as duration in the decline of the economic activity (note that, the rule of thumb solely relies on the duration of the decline of real GDP) and ii) broader indicators than only real GDP. Also the NBER uses monthly data while our calculation in problem 2.16 uses quarterly. This can shift dates. For example, if recession starts in March (i.e. in the first quarter), real GDP for the whole first quarter might not show a fall. Our rule of thumb would put the peak a quarter later than the NBER.

Table 5.1.1: NBER Recessions and the Two-quarter Rule

Recession period from NBER	The corresponding recession period from problem 2.16
1948:4-1949:4	1948:4-1949:2
1953:3-1954:2	1953:2-1954:1
1957:3-1958:2	1957:3-1958:1
1960:2-1961:1	na
1969:4-1970:4	1969:3-1970:1
1973:4-1975:1	1974:2-1975:1
1980:1-1980:3	1980:1-1980:3
1981:3-1982:4	1981:3-1982:1
1990:3-1991:1	1990:2-1991:1
2001:1-2001:4	na
2007:4-2009:2	2008:2-2009:2

Problem 5.2:

(a) & (b)

Table 5.2.1: Characteristics of the U.S. Business Cycle

	(a) After 1945	(b) Before 1942
	Date and duration (in months)	Date and duration (in months)
Shortest recession	January 1980 –July 1980 (6 months)	August 1918 – March 1919 (7 months)
Shortest boom	July 1980- July 1981 (12 months)	March 1919 – January 1920 (10 months)
Shortest peak to peak	January 1980-July 1981 (18 months)	August 1918-January 1920 (17 months)
Shortest trough to trough	July 1980-November 1982 (28 months)	March 1919-July 1921 (28 months)
Longest recession	December 2007-June 2009 (18 months)	October 1873-March 1879 (65 months)
Longest boom	March 1991-March 2001 (120 months)	June 1938-February 1945* (80 months)
Longest peak to peak	July 1990-March 2001 (128 months)	October 1873-March 1882 (101 months)
Longest trough to trough	March 1991-November 2001 (128 months)	December 1870-March 1879 (99 months)
Median recession	10 months	18 months
Median boom	45 months	23 months
Median peak to peak	56 months	41 months
Median trough to trough	55 months	42.5 months

* If for the period strictly before 1942, the longest boom is March 1933-May 1937 (50 months)

- (c) Some noticeably different characteristics before 1942 and after 1945 are as follows
1. *The duration of the boom is longer after 1945:* a) the median boom 45 months post-1945 versus 23 months pre-1942; b) the longest boom post-1945 is 120 months versus 50 months pre-1942.
 2. *The duration of the recession is shorter after 1945:* a) the median slump post-1945 is 10 months versus 18 months pre-1942; the longest recession post-1945 is 18 months versus pre-1945 65 months.
 3. *The duration of the complete cycle seems to be more than a year longer after 1945:* compare the complete cycles: peak-to-peak (56 months post-1945 versus 41 months pre-1942) or trough to trough (55 versus 42.5 months).

***Problem 5.3:**

Table 5.3.1. Characteristics of U.S. Business Cycles: 1947-present
 (percentage change in real GDP)

	Mean	Median
Recession series	-1.8	-2.2
Expansion series	24.9	20.6
Trough to trough series	22.7	16.8
Peak to peak series	23.0	19.0

Note: Table 3 is based on Tables 5.3.2 and 5.3.3 below.

Table 5.3.2.
Percentage Change in Real GDP in Recessions and Expansions: 1947- Present

Recession	Percentage change	Expansion	Percentage change
1948:4-1949:4	-1.5	1949:4-1953:2	29.4
1953:2-1954:2	-2.4	1954:2-1957:3	13.6
1957:3-1958:2	-3.0	1958:2-1960:2	11.5
1960:2-1961:1	-0.3	1961:1-1969:4	52.0
1969:4-1970:4	-0.2	1970:4-1973:4	16.0
1973:4-1975:1	-3.1	1975:1-1980:1	23.3
1980:1-1980:3	-2.2	1980:3-1981:3	4.4
1981:3-1982:4	-2.5	1982:4-1990:3	38.4
1990:3-1991:1	-1.3	1991:1-2001:1	42.6
2001:1-2001:4	+0.5	2001:4-2007:4	18.0
2007:4-2009:2	-4.2		
Mean	-1.8		24.9
Median	-2.2		20.6

Table 5.3.3.
Percentage Change in Real GDP in Complete Cycles: 1947- Present

Trough to trough	Percentage change	Peak to peak	Percentage change
1949:4-1954:2	26.2	1948:4-1953:2	27.4
1954:2-1958:2	10.3	1953:3-1957:3	11.5
1958:2-1961:1	11.2	1957:3-1960:2	8.2
1961:1-1970:4	51.8	1960:2-1969:4	51.6
1970:4-1975:1	12.4	1969:4-1973:4	15.8
1975:1-1980:3	20.6	1973:4-1980:1	19.5
1980:3-1982:4	1.7	1980:1-1981:3	2.1
1982:4-1991:1	36.5	1981:3-1990:3	34.8
1991:1-2001:4	43.3	1990:3-2001:1	40.7
2001:4-2009:2	13.0	2001:1-2007:4	18.6
Mean	22.7		23.0
Median	16.8		19.0

Problem 5.4:

Table 5.4.1. Characteristics of U.S. Business Cycles: 1947-present
 (change in the unemployment rate – percentage points)

	Mean	Median
Recession series	2.8	3.3
Expansion series	-2.5	-2.3
Trough to trough series	0.2	-0.7
Peak to peak series	0.1	0.8

Note: Table 6 is based on Tables 5.4.2 and 5.4.3 below.

Table 5.4.2.
Change in the Unemployment Rate in Recessions and Expansions: 1947- Present

Recession	Change (percentage points)	Expansion	Change (percentage points)
1948:11-1949:10	4.1	1949:10-1953:07	-5.3
1953:07-1954:05	3.3	1954:05-1957:08	-1.8
1957:08-1958:04	3.3	1958:04-1960:04	-2.2
1960:04-1961:02	1.7	1961:02-1969:12	-3.4
1969:12-1970:11	2.4	1970:11-1973:11	-1.1
1973:11-1975:03	3.8	1975:03-1980:01	-2.3
1980:01-1980:07	1.5	1980:07-1981:07	-0.6
1981:07-1982:11	3.6	1982:11-1990:07	-5.3
1990:07-1991:03	1.3	1991:03-2001:03	-2.5
2001:03-2001:11	1.2	2001:11-2007:12	-0.5
2007:12-2009:06	4.5		
Mean	2.8		-2.5
Median	3.3		-2.3

Table 5.4.3.
Change in the Unemployment Rate in Complete Cycles: 1947- Present

Trough to trough	Change (percentage points)	Peak to peak	Change (percentage points)
1949:10-1954:05	-2.0	1948:11-1953:07	-1.2
1954:05-1958:04	1.5	1953:07-1957:08	1.5
1958:04-1961:02	-0.5	1957:08-1960:04	1.1
1961:02-1970:11	-1.0	1960:04-1969:12	-1.7
1970:11-1975:03	2.7	1969:12-1973:11	1.3
1975:03-1980:07	-0.8	1973:11-1980:01	1.5
1980:07-1982:11	3.0	1980:01-1981:07	0.9
1982:11-1991:03	-4.0	1981:07-1990:07	-1.7
1991:03-2001:11	-1.3	1990:07-2001:03	-1.2
2001:11-2009:06	4.0	2001:03-2007:12	0.7
Mean	0.2		0.1
Median	-0.7		0.8

Problem 5.5: For the “typical” post-World War II business cycle, on average, real GDP falls about 1.8 percent during the recession while it increases 24.9 percent during the expansion. The unemployment rate rises, on average, 2.8 percent during the recession while it falls 2.5 percent during the expansion. Changes in unemployment rates are highly variable across

different cycles, but the mean values show that the gains in booms more or less offset losses in recessions. Unemployment rates, of course, tend to move in the opposite direction to real GDP.

The typical recession during post-World War II lasts about 10 months (as measured by the median recession) while the expansion lasts about 45 months. Far from being symmetrical, business cycles are four steps forward and one step back. Gains to GDP in expansions exceed losses in recessions by more than 13 times. In the U.S., trend growth overwhelms cyclical fluctuations.

For a complete cycle, the real GDP increases, on average about 23 percent. The complete cycle lasts about 56 months about 4½ years (as measured by the median peak-to-peak complete cycle – median trough-to-trough is similar). The business cycle seems to be becoming stretched out over time: the last three complete cycles are include the first, third, and fourth longest recorded.

Problem 5.6: There are four hypothesis indicated in the question:

- A. big expansions are followed by big recessions (and small by small): *correlation #1 should be positive.*
- B. big recessions are followed by big expansions (and small by small): *correlation #2 should be positive.*
- C. small recessions are followed by big recoveries (and big by small). *correlation #2 should be negative.*
- D. expansions and recessions are essentially uncorrelated: *both correlations should be small.*

The evidence:

correlation #1 (expansion and the subsequent recession) = -0.61

correlation #2 (recession and the subsequent expansion) = -0.24

Hypothesis A and B are both ruled out, since both correlations are negative. Hypothesis D depends on whether the two correlations are small (in absolute value) to count as zero, and that depends on the size of the sample and statistical tests that are beyond this book; but it is fair to say that correlation #1 is not small and correlation #2 is middling (perhaps small enough to be zero, perhaps not). But in any case, Hypothesis D is not supported.

Another hypothesis, not suggested in the question, is

- E. big expansions are followed by small recessions (and small by big): *correlation #1 should be negative.*

Thus both Hypotheses C and D are supported. The two hypotheses suggest some patterns. On the one hand, we could have a *virtuous circle*: *large expansion* → *small recession* → *large expansion* → *small recession* → *large expansion*. But we could also have a *vicious*

circle: large recession → small expansion → large recession → small expansion → large recession. Because the correlations are not perfect, we should expect these chains to break down from time to time, and breaking down could mean switching from a virtuous circle to a vicious one or vice versa. Recent history has supported the circular pattern. The large expansion of the mid- to late-1980s was followed by a weak recession in the early 1990s, followed by the strong expansion of the later 1990s, followed by the very weak recession of the early 2000s, followed by the relatively strong expansion of the early 2000. This looks like a virtuous circle. But then the Great Recession of 2007-09 occurred. The recovery since then has been relatively weak, suggesting that we may have slipped from a virtuous to a vicious circle.