

# Homework 10 (96 Points)

*Note.* This homework needs to be written in `R Markdown` and submitted in either `html` or `pdf` format.

## Part I

### Multiple Choices (2 Points Each)

1. In an imaginary economy, consumers buy only sandwiches and magazines. The fixed basket consists of 20 sandwiches and 30 magazines. In 2006, a sandwich cost \$4 and a magazine cost \$2. In 2007, a sandwich cost \$5. The base year is 2006. If the consumer price index in 2007 was 125, then how much did a magazine cost in 2007?
  - (a) \$0.83
  - (b) \$2.25
  - (c) \$2.50
  - (d) \$3.00
2. Suppose the price of a quart of milk rises from \$1.00 to \$1.20 and the price of a T-shirt rises from \$8.00 to \$9.60. If the CPI rises from 150 to 195, then people likely will buy
  - (a) more milk and more T-shirts.
  - (b) more milk and fewer T-shirts.
  - (c) less milk and more T-shirts.
  - (d) less milk and fewer T-shirts.

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3. Assume most athletic apparel bought by U.S. consumers is imported from other nations. If all else is constant, an increase in the price of foreign-made athletic apparel will cause the U.S.
- (a) consumer price index and GDP deflator to increase by exactly the same amount.
  - (b) GDP deflator to increase more than the consumer price index.
  - (c) consumer price index to increase more than the GDP deflator.
  - (d) GDP deflator to decrease less than the consumer price index.
4. Ethel purchased a bag of groceries in 1970 for \$8. She purchased the same bag of groceries in 2006 for \$25. If the price index was 38.8 in 1970 and the price index was 180 in 2006, then what is the price of the 1970 bag of groceries in 2006 dollars?
- (a) \$5.39
  - (b) \$25.00
  - (c) \$29.11
  - (d) \$37.11
5. The consumer price index was 120 in 2013 and 126 in 2014. The nominal interest rate during this period was 8 percent. What was the real interest rate during this period?
- (a) 3 percent
  - (b) 2 percent
  - (c) 3.3 percent
  - (d) 12.8 percent
6. The nominal interest rate for a consumer loan lasting from 2007 to 2008 is 8.5 percent and the real interest rate is 4.5 percent. If the consumer price index was 200 in 2007, what would the consumer price index value be in 2008?
- (a) 192
  - (b) 208
  - (c) 209
  - (d) 217

## Part II

### Problem 1 (10 Points)

Consider the following economy that produces 1 good (TV) and one service (haircut).

Year	Haircut		TV	
	price	quantity	price	quantity
2000	\$20	100	\$1000	20
2001	\$30	150	\$800	15
2002	\$35	200	\$500	10

1. Let 2000 be the base year. Calculate the CPI for each year.
2. Calculate the nominal GDP for this economy in each year.
3. Let 2000 be the base year. Calculate the real GDP<sup>1</sup> for each year.
4. Let 2002 be the base year. Calculate the real GDP for each year.
5. Let 2000 be the base year. Calculate the GDP deflator for each year.

### Problem 2 (4 Points)

Given the following information:

Year	Nominal GDP (in billions of dollars)	GDP Deflator (base year 2005)
2012	15,676	115.4
2002	10,642	92.2

1. What is the *annual* growth rate of nominal GDP between 2002 and 2012?
2. What is the *annual* growth rate of real GDP between 2002 and 2012?

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<sup>1</sup>In all of the following problems, the real GDP is calculated as the **fixed-weight real GDP**.

# Part III

## Problem 1 (6 Points)

1. In one graph, plot the **annual nominal** GDP of **the U.S.**, **China**, **Germany**, **Japan**, and **Korea** from 1970 to 2015<sup>2</sup>. (2 Points)
2. In one graph, plot the **annual real** GDP *per capita*<sup>3</sup> of **the U.S.**, **China**, **Germany**, **Japan**, and **Korea** from 1970 to 2015<sup>4</sup>. (2 Points)
3. Construct a **real** GDP *per capita* index that is equal to 1 for all countries in 1970. To do this, divide each series by its 1970 value<sup>5</sup>. In one graph, plot all the series together. Which country has grown the most percentage-wise since 1970? Which country has seen the second largest growth? (2 Points)

## Problem 2 (2 Points)

In one graph, plot the **annual nominal** GDP, GNP, National Income (NI), Personal Income (PI), and Disposable Personal Income (DPI) of the U.S. from 1929 to 2015.

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<sup>2</sup>For this problem, note that the GDP of China, Germany, Japan, and Korea are in dollars, while the GDP of the U.S. is in billions of dollars. Let us turn all of them into billions of dollars. This means dividing the data for China, Germany, Japan, and Korea by 1 billion ( $10^9$ ).

<sup>3</sup>GDP *per capita* = GDP/Population.

<sup>4</sup>Note that all data series are expressed in 2010 U.S. dollars here.

<sup>5</sup>i.e., divide each year's real GDP *per capita* by 1970's real GDP per capita

## Problem 3 (8 Points)

1. Plot the **annual U.S. manufacturing labor share** from 1987 to 2014. (2 Points)
2. The manufacturing sector can be divided into a durable goods sector and a non-durable goods sector. In one graph, plot the **annual labor share in the durable goods sector** vs. the **annual labor share in the non-durable goods sector** from 1987 to 2014. (2 Points)
3. Calculate the percentage change in labor share in the durable and non-durable goods sectors from 1987 to 2014<sup>6</sup>. In which sector – durable goods or non-durable goods – has labor share changed the most during this period of time? (2 Points)
4. What can be some of the reasons behind the observed changes in U.S. manufacturing labor share? (2 Points)

## Problem 4 (4 Points)

In this problem we look at the value-added of different U.S. sectors before and after the 2008 financial crisis. To do so, download the **quarterly real** value-added of the U.S. **Manufacturing**, **Construction**, **Retail**, **Finance**, and **Healthcare** sector from 2005.Q1 to 2015.Q4<sup>7</sup>.

1. Construct an index for each sector so that 2005.Q1 = 1<sup>8</sup>. In one graph, plot all the series together. (2 Points)
2. Describe what you observe from the data. Which sector started to decline first? Which sector experienced the most precipitous decline during the financial crisis? Which sector recovered most quickly? Which sector does not seem to be negatively affected by the crisis? Which sector *still* hasn't recovered to its pre-crisis level? (2 Points)

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<sup>6</sup>  $\frac{\text{Labor share (2014)} - \text{Labor share (1987)}}{\text{Labor share (1987)}}$

<sup>7</sup>Note: in FRED, the date for Q1 is 01-Jan. The date for Q2 is 01-Apr. The date for Q3 is 01-Jul. The date for Q4 is 01-Oct.

<sup>8</sup>To do this, divide each series by its 2005Q1 value.

## Problem 5 (4 Points)

In this problem we look at three components of GDP – Consumption (C), Investment (I), and Government Spending (G) – before and after the 2008 financial crisis. Download the [quarterly](#) data on U.S. [real consumption](#), [real investment](#), and [real government spending](#) from 2003.Q1 to 2015.Q4.

1. Construct an index for each component so that  $2003.Q1 = 1$ . In one graph, plot all the series together. (2 Points)
2. Describe what you observe from the data. Which component of GDP started to decline first? Which component declined the most during the financial crisis? Which component actually *increased* during and immediately after the financial crisis? (2 Points)

## Problem 6 (4 Points)

In this problem we look at the Consumption (C), also called the Personal Consumption Expenditure (PCE), component of GDP. Consumption can be further divided into three components: consumption on durable goods, consumption on nondurable goods, and consumption on services. Download the [quarterly](#) data on U.S. [real durable goods consumption](#), [real nondurable goods consumption](#), and [real service consumption](#) from 2003.Q1 to 2015.Q4.

1. Construct an index for each component of consumption so that  $2003.Q1 = 1$ . In one graph, plot all the series together. (2 Points)
2. Describe what you observe from the data. During the recession caused by the 2008 financial crisis, consumption on which component dropped the most? Which component was least affected? After the recession, which component of consumption has been growing the fastest? (2 Points)

## Problem 7 (4 Points)

In this problem we look at the Investment (I) component of GDP. Investment can be further divided into business fixed investment, residential investment, and additions to inventory. For this problem, download the [quarterly](#) data on U.S. [real business fixed investment](#) and [real residential investment](#) from 2003.Q1 to 2015.Q4.

1. Construct an index for each component so that  $2003.Q1 = 1$ . In one graph, plot both series together. (2 Points)
2. Describe what you observe from the data. Before and during the 2008 financial crisis, when did residential investment start to decline? When did business fixed investment start to decline? When did residential investment start to recover and when did business fixed investment start to recover? (2 Points)

# Part IV

## Problem 1 (6 Points)

In this problem, we look at the **nominal** and **real** GDP of the U.S. First, download the data for **quarterly nominal GDP** and **quarterly real GDP** of the U.S. from 1950.Q1 to 2015.Q4.

1. What is the base year for the real GDP data? (2 Points)
2. In one graph, plot the **annual nominal** GDP and **annual real** GDP from 1950 to 2015. (2 Points)
3. Make a bar plot of the **annual** GDP growth rates from 1951 to 2015. (2 Points)

## Problem 2 (4 Points)

Download the **monthly** CPI of **China** and **Japan** from Jan. 2000 to Dec. 2014.

1. Calculate **year-on-year** inflation rates<sup>9</sup> based on the Chinese and Japanese CPI. In one graph, plot the Chinese and the Japanese inflation rates from Jan. 2001 to Dec. 2014. (2 Points)
2. During this period of time, how many months did Japan experience deflation? (2 Points)

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<sup>9</sup>Given monthly price indices  $\{\mathcal{P}_t\}$ , the year-on-year inflation rate is

$$\pi_t = \left( \frac{\mathcal{P}_t}{\mathcal{P}_{t-12}} - 1 \right) \times 100\%$$



## Problem 3 (18 Points)

Download the **monthly** U.S. **CPI-U**, **C-CPI-U**, and **PCEPI** from Jan. 2000 to Dec. 2015.

1. In one graph, plot all the price indices together. Note that different indices have different base periods. Let us change that by making Jan. 2000 the common base period for CPI-U, C-CPI-U, and PCEPI. To do this, divide each series by its Jan. 2000 value and then times 100, so that the Jan. 2000 value for all these series are equal to 100. (2 Points)
2. Calculate **year-on-year** inflation rates based on each index. In one graph, plot the CPI-U inflation rate, the C-CPI-U inflation rate, and the PCEPI inflation rate from Jan. 2001 to Dec. 2015. (2 Points)
3. During this period of time, inflation rates as measured by which index – CPI-U, C-CPI-U, or PCEPI – tend to be the highest, and by which index tend to be the lowest? (2 Points)

Now download the **monthly** **CPI-U less food and energy** and **PCEPI less food and energy** from Jan. 2000 to Dec. 2015.

4. Calculate and plot the **year-on-year** core CPI-U and core PCEPI inflation rates from Jan. 2001 to Dec. 2015. (2 Points)
5. In 2015,
  - (a) The core CPI-U inflation rate is (higher than/equal to/lower than) the CPI-U inflation rate. The core PCEPI inflation rate is (higher than/equal to/lower than) the PCEPI inflation rate. (2 Points)
  - (b) The CPI-U inflation rate is (higher than/equal to/lower than) the PCEPI inflation rate, while the core CPI-U inflation rate is (higher than/equal to/lower than) the core PCEPI inflation rate. (2 Points)
6. What do these observations suggest? (2 Points)

Let us now take a look at energy prices. Download the **monthly** **CPI: Energy** from Jan. 2000 to Dec. 2015. This is an index that measures energy prices in the CPI basket.

7. Calculate and plot the **year-on-year** inflation rates based on this index. (2 Points)
8. Were energy prices increasing or decreasing in 2015? What is the average energy price inflation rate in 2015 based on this index? (2 Points)

## Problem 4 (10 Points)

The Producer Price Index (PPI) comes in different flavors. One can look at PPI for all commodities (PPI: All), which includes both intermediate and final goods and services, or PPI for final goods and services only (PPI: Final). For this problem, download the [monthly](#) U.S. [CPI-U](#), [PPI: All](#) and [PPI: Final](#) from Jan. 2011 to Dec. 2015.

1. In one graph, plot the [year-on-year](#) inflation rates based on CPI-U, PPI: All, and PPI: Final from Jan. 2012 to Dec. 2015. (2 Points)
2. Which index – PPI: All or PPI: Final is more volatile? Which index tracks CPI better? (2 Points)

Read “[What’s Wrong with the Producer-Price Index?](#)”

3. According to this article, why did the U.S. PPI: Final inflation rate go negative in 2015, while the CPI inflation rate stayed mostly positive or close to zero? (2 Points)

Now download the [monthly CPI Less Shelter](#) from Jan. 2011 to Dec. 2015. This is an index that measures the cost of the CPI basket excluding housing (rent and imputed rent for owner-occupants).

4. In one graph, plot the [year-on-year](#) inflation rates based on this index and PPI: Final. Your graph should look like the one in the “[What’s Wrong with the Producer-Price Index?](#)” article. Do the two inflation rates agree with each other better in 2015? (2 Points)
5. Looking back at the plot you did for Problem 2.4. Core CPI inflation rose (faster/slower) than core PCEPI inflation in 2015. What might be the reason? (2 Points)