Instructions: Please show all work or points will be taken off. Good luck!

1. (80 points total\textsuperscript{1} – 10 points each part) In this first homework assignment, we are getting our 'hands dirty' to get familiar with some of the major macroeconomic variables that we will be using and working with throughout the semester. Our first chapter with 'something to sink our teeth into' is chapter 3 and it is all about the factors of production, the labor market, and of course, the production function. Major variables in this part of the macroeconomy (i.e., the supply side of the economy) include, but certainly are not limited to, employment (denoted N), real wages (denoted \( w = \frac{W}{P} \) where \( W = \) nominal wage and \( P = \) price index - typically the CPI) and real GDP (denoted \( Y \)). When we move to chapter 4 we encounter many more major macroeconomic variables including consumption (C), investment (I), and the real interest rate (denoted r), among others. We are going to use FRED as our source of data (many professional economists use this site, nice clean data!)\textsuperscript{1}

I provide you with the links to the data that is needed throughout this assignment. For an interesting look at the \%\( \Delta W \) vs. the \%\( \Delta P \), click Here.

As we move forward through the class, we are going to learn about some “business cycle facts.” See page 290 in text, Chapter 8. In this first question, among other things, we are going to investigate the behavior of the real wage over the most recent business cycle. (Click Here for the NBER site - look at right hand side of page for the official dates of

\textsuperscript{1} FRED stands for Federal Reserve Economic Data.- click Here for the FRED website
the most previous 4 recessions). In particular, we are going to calculate the percent change in the real wage during the most recent recession (12/07 – 6/09) and compare it to the percent change during the most recent recovery, 7/09 to the present.

Use the following two links to answer the following questions:

For Nominal Wages (W)   Click Here
Price index  CPI (P)   Click Here

a) Calculate the real wage (W/P) the first month of the recession 12/07 and compare it to the last month of the recession 6/09. What is the percent change in the real wage during this most recent recession?

\[
\begin{align*}
12/07 & \rightarrow \frac{W}{P} = \frac{17.70}{2.1141} = 8.3721 \\
6/09 & \rightarrow \frac{W}{P} = \frac{18.68}{2.14527} = 8.6099 \\
\frac{8.6099 - 8.3721}{8.3721} & = 0.3379 = 3.45\% \\
\end{align*}
\]

In class we argued that a good approximation of the percent change of the real wage can be obtained with the following expression:

\[
\% \Delta (W/P) = \% \Delta W - \% \Delta P
\]

b) Using the expression above, re-calculate the percent change in the real wage during the most recent recession (12/07 – 6/09) and compare to your answer in part a). Does the expression above serve as a good approximation (i.e., is your answer similar to your answer in part a)? Please show all work.

\[
\begin{align*}
\% \Delta W & = \frac{18.68 - 17.70}{17.70} = 4.97\% \\
\% \Delta P & = \frac{2.14527 - 2.11416}{2.11416} = 1.47\% \\
\% \Delta \frac{W}{P} & = \% \Delta W - \% \Delta P = 4.97\% - 1.47\% = 3.5\% \\
\end{align*}
\]

Yes, it is a good approximation.

\[2\text{ Hint, when deflating using a price index, we typically move the decimal two place to the left. For example, in 12/09 } W = \$18.80 \text{ and the price index was 217.541. The real wage is thus 18.80 divided by 2.17541.}\]
c) Now calculate the real wage during the first month of the recovery, 7/09 and compare it to the real wage according to the most recent data. What is the percent change in the real wage during this recovery thus far?

\[
\frac{W}{P} = \frac{18.65}{2.14782} = 8.673
\]

\[
\frac{\text{Present}}{\text{Past}} = \frac{19.54}{2.26741} = 8.6175
\]

\[
\% \Delta W = \frac{8.6175 - 8.673}{8.673} = -0.6399\%
\]

d) According to the business cycle facts, the real wage is 'pro-cyclical' suggesting that the real wage moves directly (shares a positive relationship) with the state of the economy (GDP) growth. Another element of the business cycle fact(s) of economic time series is its timing: i.e., whether the economic variable is leading, coincident, or lagging (click Here for help with these terms and/or read pages 284-285 in text). According to your results above, how would you characterize the behavior of the real wage during this business cycle in terms of: 1) it's cyclicality and 2) it's timing. Please consider all three of the possible timings (since we are not sure) and then determine its cyclicality, based on the timing. There are three cases to consider.

- **Leading**: Pro-cyclical \( \rightarrow \) If the timing is leading then during the recession, when real wage is increasing, it is predicting the recovery which does occur as the growth of real wage.

- **Coincident**: Counter-cyclical \( \rightarrow \) It is counter cyclical because when we are in recession and GDP is shrinking, the real wage is growing, when in recovery it real wage is shrinking the GDP is growing.

- **Lagging**: Pro-cyclical \( \rightarrow \) During the recession in real wage is increasing, but slightly.

e) The last four years of the Clinton Administration were arguably the absolute best in terms of the recent performance of the US economy (1/97 - 12/00). When we get to Chapter 3, we will discuss this period in much more detail and we refer to this period as the "new economy." Of course one metric of the health of any economy is the behavior of the real wage. In this part, we repeat the analysis above but use the final four years of the Clinton Administration. In particular, calculate the real wage \((W/P)\) the first month of Clinton's second term (1/97) and compare it to the last month of Clinton's second term(12/00). Did real wages rise or fall during this period? Please show all work.

\[
\frac{W}{P} = \frac{12.29}{1.5945} = 7.7110
\]

\[
\frac{12/00}{07/00} = \frac{14.128}{1.746} = 8.178
\]

\[
\frac{8.178 - 7.7110}{7.7110} = 6.07\% \text{ increase}
\]

Real wages increased 6.07% from 7.7110 to 8.178.
f) In Florida, I used to fish on a party boat and tip the captain and mate every time I went fishing. Given that this was back in June of 2003 and that the tip was $20, how much would the tip have to be now to equal the same purchasing power that $20 had back in June of 2003? Use the CPI (the same price index that you have been using thus far) for your calculations. Please show all work.

\[
\text{CPI}_{03} - \text{CPI}_{11} = \frac{226.747 - 183.10}{183.10} = 23.85\% \quad \text{inflation}
\]

\[
5 \times 1,238.5 = 6,192.5
\]

New Tip = 20 + 4.77

New Tip = $24.77

g) Calculate the real wage when you were born and compare it to the real wage as of the present (make sure you write down the month and year you were born so we can verify your answer). Which real wage is higher and why? To answer, compare the percent change in \( W \) to the percent change in \( P \) over this time horizon.

\[
\text{August 1972} - 1 \frac{w}{p} = \frac{10.82}{1.08} = 7.684
\]

\[
12/11 - 1 \frac{w}{p} = \frac{19.84}{226.747} = 8.67
\]

\[
%W = 80.59\% \\
%(W - \%P) = \%W - \%P = 80.59 - 61.04 = 19.55\% \quad \text{increase in real wage!}
\]

\[
%P = 61.04\%
\]

To answer h) you need to use the following link:

Employment (N)  Click Here

h) Draw a graph with the real wage \((w=W/P)\) on the vertical axis and employment \((N)\) on the horizontal axis. Locate the initial conditions (when you were born) as point A and the conditions as of the present as point B. Use actual numbers and label your points accordingly. You graph should have two points and no lines. How many more people are working now relative to when you were born (hint, the answer is in millions)?

\[
8/92 - \frac{10.82}{1.08} = 7.68 = \frac{w}{p}
\]

\[
12/11 = \frac{19.54}{226.747} = 8.61 = \frac{w}{p}
\]

\[
131,900 - 108,852 = 23,048
\]

23,048 million new workers since I was born.
2. (60 POINTS total - 10 points each part) Another critically important real economic variable we consider in this homework assignment is the real interest rate. We learned that the real interest rate is the difference between nominal interest rates and inflation. In fact, there are two real interest rates: ex-ante and ex-post. Ex-ante real interest rates are the expected real rates where ex-post real interest rates are the real rates that were actually realized. An example will help. Suppose one year nominal interest rates are 5% and you expect that prices are going to rise by 3% (i.e., your expected rate of inflation ($\pi^e$) is 3%) over the holding period = one year. Your ex-ante or expected real rate of interest is therefore 2%. Now suppose that over the year inflation wasn't 3% but 4% instead (your expectation rate of inflation was wrong). That is, actual inflation ($\pi$) equaled 4% and thus your actual real rate, referred to as the ex-post real rate of interest is only 1%. Naturally, ex-ante and ex-post real interest rates differ anytime expectations of inflation are different than the actual rate of inflation. To summarize, the ex-ante real rate is equal to $i - \pi^e$ where the ex-post real rate is equal to $i - \pi$. In general, it is the ex-ante rate that is most important since we base decisions today, in part, on expectations of the future (decision making under uncertainty!!!!).

In this problem, we are going to calculate real interest rates, both ex-post and ex-ante. The data you need for this problem are given below:

Nominal one year rates (i)  Click Here
Price index  CPI (P)  Click Here
Expected Inflation  Click Here

A couple notes are in order.

i) Expected inflation data is one year hence - so for example, expected inflation for the period from July 2010 to July 2011 is given in July 2010 and if you view the data, the expected inflation during this time is 2.7% = $\pi^e$.

ii) To calculate the actual rate of inflation, for example, during the July 2010 to July 2011 period you need to take the percent change in $P = \%\Delta P$. Using the CPI data, we have the price index equaling 217.6 in 7/2010 (beginning of August given the end of month data) and 225.4 in 7/2011 (end of July, 2011). Note, this is a 12 month period. The actual rate of inflation during this time is 3.58% = $\pi$.

iii) When using the one year nominal interest rate to calculate the all important real rate(s) of interest we need to be careful. For example, using the same one year time period (July 2010 - July 2011) we simply use the one year rate given as of July 2010. Think of buying the bond in July 2010, putting it in a safety deposit box (or under your
mattress, a coffee can, etc.) and then cashing it in when it matures in July 2011 (you get your principal times whatever the nominal interest rate is). In viewing the data, the one year rate in July 2010 is 0.29%. So clearly (and by design of the Fed), both the ex-ante and ex-post real rate are negative during this period and differ because expected inflation was not equal to actual inflation.

2 a) Calculate the ex-ante and ex-post real rate of interest between June 2008 and June 2009 (note that June 2009 is the last month of the Great recession - the official recovery, the one we are in now, began in July of 2009). Why are these real rates so different? Again, please show all work.

Ex-Ante = 2.42%  
Ex-Post = 3.67%

The ex-ante and ex-post rates are so different because the actual rate of inflation, 1.246%, is extremely different from the expected rate of inflation, 5.14%.

b) We know that most decisions are in part, based on expectations of the future. Suppose we have two people who are trying to decide whether to consume today (June 2008) or save for the future and consume one year later, in June 2009. One person, let's call him Joe, is basing their decision on the ex-ante real rate of interest like most of us do. The other person who has a crystal ball, we’ll call her Crystal, can see exactly what the actual rate of inflation is going to be and thus, has perfect foresight and bases their decision on the ex-post real rate. Given the difference in the ex-ante and ex-post real rates above, who would be more likely to save and who would be more likely to spend? Explain in detail and feel free to use the shopping cart example we used in class.

Joe would be most likely to spend the money because the real, ex-ante, rate of interest is negative. He won't recover any increase in value if he saves his money, and because inflation is 5.14%, he thinks products will only get more expensive.

Crystal would save her money because the ex-post rate of interest is positive showing that by saving her money it will increase in value. Also, she will be much better off waiting to spend because 1.246% deflation means that things will be cheaper to purchase in the future.

We discussed the evils of deflation.

c) From a macroeconomic perspective, why is deflation so bad? Please refer to consumer behavior and the corresponding behavior of firms in a deflationary environment.

Deflation is terrible because during a period of deflation, consumers will wait to buy any non-essential products because they know prices will fall in the future. This causes company's earnings and sales to decrease and inventories to rise. To combat this, firms must cut costs and do so by laying people off. The people who are now jobless have even less spending money and wait even longer to buy products only further hurting businesses leading to further lay offs and downturn in the economy as the vicious cycle of inflation continues.
d) Now discuss the fact that deflation is the central bank's worst nightmare. Make sure you refer to either the ex-post or ex-ante real rate that you calculated above, whichever applies. Why is this environment such a nightmare for the central bank and monetary policy? Explain using the equation for the real rate of interest.

The ex-post real rate of interest applies because it shows deflation occurring in the economy. During a time of deflation, a deflation even if the central bank lowers nominal rates of interest, the ex-post real rate will still be positive because subtracting a negative inflation number results in a positive real interest rate. With a positive ex-post real rate, consumers would save their money only during more harm to the economy and forcing the Fed to take more extreme types of action.

\[ r = \frac{1 + i}{1 + \pi} \]

\( r = 0 \) \( -(1.246) = 1.246\% \)

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e) Suppose Joe, from part b) above, changes his expectation of inflation to equal the actual rate of inflation that occurred between June 2008 and June 2009. What is the lowest the ex-ante interest rate can go, given the change in Joe's inflationary expectations. Click Here for a hint!

The lowest the ex-ante real interest rate can go is 1.246\% because the Federal Reserve can only lower nominal interest rates to 0\%, and deflation would mean subtracting a negative, or adding in deflation.

\[ r = 0 - (1.246) = 1.246\% \]

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f) Given a deflationary environment, what can the central bank do to rid themselves of the nightmare? Explain. Click Here and Here for a hint! Explain why this move should work in terms getting rid of the nightmare.

The Federal Reserve could lower nominal interest rates to 0\% to encourage spending and make an incentive for people to not hold onto their savings. Also, the Fed could conduct rounds of quantitative easing when they buy US treasury bonds from banks and large institutional investors, increasing the money supply in the economy. As the money supply increases, each dollar is worth less money and inflation sets in creating an incentive for people to spend now.
3. (50 points total – 10 points each part) Real vs nominal GDP. When we get to chapter three we consider a production function where the output of all our factors of production is of course real GDP. Recall that Nominal GDP is the total value of goods and services produced at current prices where real GDP is the total value of goods and services expressed in constant prices (we deflate nominal GDP by a price index called the GDP deflator). The links for the data used in this problem are below.

<table>
<thead>
<tr>
<th>Nominal GDP</th>
<th>GDP</th>
<th>GDP Deflator (P)</th>
<th>GDPCTPI</th>
</tr>
</thead>
</table>

a) Let us go back to the 1981 – 1982 recession – Click here for the NBER site. Note that officially, this recession began in third quarter of 1981 and ended in the fourth quarter of 1982. Calculate the percent change in nominal GDP during this recession (for all calculations use the data from 1981-07-01 to 1982-10-01 (GDP data is quarterly).

\[
\frac{3312.5 - 3171.7}{3171.7} = 4.27\% \quad \text{increase in nominal GDP}
\]

b) Now calculate the percent change in the GDP price deflator during this recession.

\[
\frac{52.799 - 52.711}{52.711} = 1.63\% \quad \text{increase in prices}
\]
c) Now calculate the percent change in real GDP using the formula:

\[ \% \Delta RGDP = \% \Delta (NGDP/P) = \% \Delta NGDP - \% \Delta P \]

where \( RGDP \) = real GDP; \( NGDP \) = nominal GDP; \( P \) = the GDP deflator

\[ \% \Delta RGDP = \% \Delta NGDP - \% \Delta P \]
\[ = 4.27\% - 7.03\% \]
\[ \% \Delta RGDP = -2.76\% \]

d) What is this period often referred to and why (starts with S!)?

This period is referred to as stagflation. It is referred to as stagflation because the economy is in a recession with negative real GDP growth and the economy has high inflation. Real GDP is falling as prices are steadily rising.

e) Finally, draw a graph with the general price level on the vertical axis (the GDP deflator) and real GDP on the horizontal axis (note, you need to calculate real GDP using \( NGDP/P \) for two different time periods). Label the initial point (the beginning of recession) as point A and the end point (the end of recession) as point B. Be sure to label graph completely using the specific numbers you calculated above.

\[ 7/81 \rightarrow \frac{3177}{52.51} = 60.17 \]
\[ 10/82 \rightarrow \frac{3312}{52.79} = 63.61 \]