Practice Problems on NIPA and Key Prices

1- What are the three approaches to measuring economic activity? Why do they give the same answer?

The three approaches to national income accounting are the product approach, the income approach, and the expenditure approach. They all give the same answer because they are designed that way; any entry based on one approach has an entry in the other approaches with the same value. Whenever output is produced and sold, its production is counted in the approach, its sale counted in the expenditure approach, and the funds received by the seller are counted in the income approach.

2- What is the difference between intermediate and final goods and services? In which of these categories do capital goods, such as factories and machines, fall? Why is the distinction between intermediate and final goods important for measuring GDP?

Intermediate goods and services are used up in producing other goods in the same period (year) in which they were produced, while final goods and services are those that are purchased by consumers or are capital goods that are used to produce future output. The distinction is important, because we want to count only the value of final goods produced in the economy, not the value of goods produced each step along the way.

3- List the four components of total spending. Why are imports subtracted when GDP is calculated in the expenditure approach?

The four components of spending are consumption, investment, government purchases, and net exports. Imports must be subtracted, because they are produced abroad and we want GDP to count only those goods and services produced within the country. For example, suppose a car built in Japan is imported into the United States. The car counts as consumption spending in U.S. GDP, but is subtracted as an import as well, so on net it does not affect U.S. GDP. However, it is counted in Japan’s GDP as an export.

4- Define private saving. How is private saving used in the economy? What is the relationship between private saving and national saving?

Private saving is private disposable income minus consumption. Private disposable income is total output minus taxes paid plus transfers and interest received from the government. Private saving is used to finance investment spending, the government budget deficit, and the current account. National saving is private saving plus government saving.

5- For the purposes of assessing an economy’s growth performance, which is the more important statistic: real GDP or nominal GDP? Why?

Real GDP is the useful concept for figuring out a country’s growth performance. Nominal GDP may rise because of increases in prices rather than growth in real output.
6- Describe how CPI and CPI inflation are calculated. What are some reasons that CPI inflation may overstate true inflation?

The CPI is a price index that is calculated as the value of a fixed set of consumer goods and services at current prices divided by the value of the fixed set at base-year prices. CPI inflation is the growth rate of the CPI. CPI inflation overstates true inflation because it is hard to measure changes in quality, and because the price index doesn’t account for substitution away from goods that become relatively more expensive towards goods that become relatively cheaper.

7- Explain the differences among the nominal interest rate, the real interest rate, and the expected real interest rate. Which interest rate concept is the most important for the decisions made by borrowers and lenders? Why?

The nominal interest rate is the rate at which the nominal (or dollar) value of an asset increases over time. The real interest rate is the rate at which the real value or purchasing power of an asset increases over time, and is equal to the nominal interest rate minus the inflation rate. The expected real interest rate is the rate at which the real value of an asset is expected to increase over time. It is equal to the nominal interest rate minus the expected inflation rate. The concept that is most important to borrowers and lenders is the expected real interest rate, because it affects their decisions to borrow or lend.

8- Consumer expenditures on durable goods such as cars and furniture, as well as purchases of new houses, fall much more than expenditures on non-durable goods and services during recessions. Why do you think that is?

Expenditure on durable goods is more sensitive to the business cycle than expenditure on non-durable goods and services, because people can more easily change the timing of their expenditure on durables. When economic activity is weak, and people face the danger of losing their jobs, they avoid making durable goods purchase. Instead, they may drive their cars a little longer before buying new ones, get the old washing machine repaired instead of buying a new one, and put off buying new furniture until a new expansion indicates greater income security. So in a recession, durable purchases decline a lot, but when an expansion begins, durable purchases pick up substantially.

9- Price indexes (Chain Weighting)

This problem requires you to understand the difference between three main price indexes: the fixed – weight index, the variable-weight index and the chained-weight index.
The fixed-weight index takes the quantities in the base year as fixed weights. To compute this index for a given year evaluate the value of the fixed weights at the prices prevailing in that year and divide that value with the value of the fixed weights, evaluated at base year prices. Note that the base year, once chosen, does not change.

The variable-weight index takes the prices in the base year as fixed. To compute this index for a given year evaluate the value of the output in that year at the prices prevailing in that year and divide that value with the value of the same output, evaluated at base year prices. Again note that the base year, once chosen, does not change.

The chained-weighted price index is a combination of the above two. To compute a chained-weighted index, compute both the fixed-weight and the variable-weight index for two consecutive years. The chain-weighted index is the geometric average of the two. That is the square root of the product of the above two indexes. For example: the fixed-weight price index is equal to 1.20 and the variable-weight price index is equal to 1.1. Then the chained-weighted price index is 
\[(1.20 \times 1.10)^{0.5} = 1.1489.\] Note that in the chained-weighted index the base year always refers to the year just before the current year, that is it changes with time.

Using all these indexes compute the price changes for the following economy:

**Prices and production of haircuts**

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$10</td>
<td>$14</td>
<td>$18</td>
</tr>
<tr>
<td>Quantity</td>
<td>20,000</td>
<td>20,500</td>
<td>21,000</td>
</tr>
</tbody>
</table>

**Prices and production of mobile phones**

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$100</td>
<td>$105</td>
<td>$110</td>
</tr>
<tr>
<td>Quantity</td>
<td>3,000</td>
<td>4,000</td>
<td>6,000</td>
</tr>
</tbody>
</table>

Assume that for the calculations involving the fixed-weight and variable-weight indexes the base year is 1997.

1. Compute the rate of inflation in 1998 and 1999 using the fixed-weight price index.
2. Compute the rate of inflation in 1998 and 1999 using the variable-weight price index.
3. Compute the rate of inflation in 1998 and 1999 using the chain-weighted price index.
4. Compute real GDP growth rate in 1998 and 1999 by deflating nominal GDP's in the above three years using the above three price indexes.

**Solution:**
Y_{1997}=\$10 \times 20,000 + \$100 \times 3,000 = \$500,000 \\
Y_{1998}=\$14 \times 20,500 + \$105 \times 4,000 = \$707,000 \\
Y_{1999}=\$18 \times 21,000 + \$110 \times 6,000 = \$1,038,000

**Fixed Weight Price Index**

Second, compute the price levels in 1998 and 1999 using the fixed-weight price index. The weights are output quantities in 1999, that is 20,000 haircuts and 3,000 mobile phones. To compute the price index evaluate these quantities at the prices of the year under consideration.

Note that the price index is normalized to be 1 in year 1997.

\[
P_{\text{L}}^{1998} = \frac{(20,000 \times \$14 + 3,000 \times \$105)}{Y_{1997}} = 1.1900 \\
P_{\text{L}}^{1999} = \frac{(20,000 \times \$18 + 3,000 \times \$110)}{Y_{1997}} = 1.3800
\]

**Variable Weight Price Index**

Third, compute the price levels in 1998 and 1999 using the variable-weight index. To compute this index use the 1997 prices, and vary the quantities – the quantities are those from the year under consideration. Note that the price index is normalized to be 1 in year 1997.

\[
P_{\text{P}}^{1998} = \frac{Y_{1998}}{(20,500 \times \$10 + 4,000 \times \$100)} = 1.168595 \\
P_{\text{P}}^{1999} = \frac{Y_{1999}}{(21,000 \times \$10 + 6,000 \times \$100)} = 1.281481
\]

**Chain-weighted Price Index**

Fourth, compute the price levels in 1998 and 1999 using the chain-weighted index, that is the price index that is the geometric average of the fixed-weight and the variable-weight indexes. Note that the base year is no longer fixed at 1997!

\[
P_{\text{C}}^{1998} = (P_{\text{L}}^{1998} \times P_{\text{P}}^{1998})^{0.5} = 1.179249
\]

The calculation of the chain-weighted price index for 1999 must take into account that the base year has shifted to 1998. That means we have to compute the geometric average of the fixed-weight and the variable-weight index whose values are computed using 1998 to be the base year.

It follows

\[
P_{\text{L}}^{1999} = \frac{(20,500 \times \$18 + 4,000 \times \$110)}{Y_{1998}} = 1.1443 \\
P_{\text{P}}^{1999} = \frac{Y_{1999}}{(21,000 \times \$14 + 6,000 \times \$105)} = 1.1234
Make sure you DO NOT confuse these values with those of $P^l_{1999}$ and $P^p_{1999}$ written above – the base years are not the same!

$$P^c_{1999} = (P^l_{1999} \times P^p_{1999})^{0.5} = 1.1338$$

**Inflation**

Once we have the price indexes the inflation rates follow from the formula we derived in class. Inflation rates for 1998 and 1999 using the three indexes are listed below. The annual inflation rate for a given year, with $P_t$ being the price-index for year $t$, is

$$\left(\frac{P_t}{P_{t-1}}\right) - 1 \times 100$$

Note that for chain-weighted price index $P_{t-1} = 1$, as the base year is always chosen as the previous year.

<table>
<thead>
<tr>
<th>Using index</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>fixed-weight</td>
<td>19.00%</td>
<td>15.97%</td>
</tr>
<tr>
<td>variable-weight</td>
<td>16.86%</td>
<td>9.66%</td>
</tr>
<tr>
<td>chained-weighted</td>
<td>17.92%</td>
<td>13.38%</td>
</tr>
</tbody>
</table>

**Real GDP**

Using the three price indexes we can also compute the real GDP for all three years by taking the nominal GDP for a given year and dividing it by the appropriate price index. Hence real GDP for year $t$, is $y_t = \frac{Y_t}{P_t}$, where $Y_t$ is the nominal GDP for year $t$.

<table>
<thead>
<tr>
<th>Using index</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>fixed-weight</td>
<td>$500,000$</td>
<td>$594,118$</td>
<td>$752,174$</td>
</tr>
<tr>
<td>variable-weight</td>
<td>$500,000$</td>
<td>$605,000$</td>
<td>$810,000$</td>
</tr>
<tr>
<td>chain-weighted</td>
<td>$500,000$</td>
<td>$599,534$</td>
<td>$915,505$</td>
</tr>
</tbody>
</table>

Note that the 1999 product in the chain-weighted row is measured in 1998 dollars!

**Real GDP Growth Rate**

The final calculation involves the growth rates of real GDP. Using the numbers in the table above we get the following real GDP growth rates. If $y_t$ is the real GDP for year $t$, then the annual real GDP growth rate is

$$\left(\frac{y_t}{y_{t-1}}\right) - 1 \times 100$$

Note that to compute real GDP growth rate using the chain-weighted method for date $t$ we used the last year as the base year to compute the price index, consequently we must set $y_{t-1} = Y_{t-1}$. That is the previous year's nominal GDP (the base year for Chain-weight) is treated as the real GDP for the previous year.)
Using index  1998   1999  
fixed-weight  18.82%  26.60%  
variable-weight  21.00%  33.88%  
Chain-weighted  19.91%  29.49%  

Remark: The differences across price indexes and implied growth rates for GDP in this example are much bigger than in real life. The numbers in this example were chosen to amplify the differences.

10- Real and nominal interest rates
Hy Marks buys a one-year government bond on January 1, 1997, for $500. He receives principal plus interest totaling $545 on January 1, 1998. Suppose that the CPI is 200 in January 1, 1997 and 214 on January 1, 1998. This increase in prices is more than Hy had anticipated; his guess was that the CPI would be at 210 at the beginning of 1998. Compute the following and report them as annual percentage points.

a) Nominal interest rate  
\[ i = \frac{545}{500} - 1 \times 100 = 9\% \]

b) The inflation rate (\( \pi \))  
\[ \pi = \left( \frac{214}{200} - 1 \right) \times 100 = 7\% \]

c) The real interest rate  
\[ r = \left( \frac{1 + i}{1 + \pi} - 1 \right) \times 100 = 1.86\% \]

If you use the approximate formula \( r = i - \pi \) you get the answer \( r = i - \pi = 2\% \) Both methods of computing the real interest rate are acceptable.

d) Hy's expected inflation rate  
\[ \pi_{Hy} = \left( \frac{210}{200} - 1 \right) \times 100 = 5\% \]

e) Hy's expected real interest rate  
\[ r^e = \left( \frac{1 + i}{1 + \pi_{Hy}} - 1 \right) \times 100 = 3.81\% \]

If you use the approximate formula \( r^e = i - \pi_{Hy} \) you get the answer \( r^e = i - \pi_{Hy} = 4\% \). Both methods of computing the expected real interest rate are acceptable.
11- **Problem on NIPA**

Gross national product 1000
Government purchases of goods and services 200
Government deficit 50
National saving 200
Investment 150
Net factor payments from abroad 25

Find the following:

a) Consumption. Answer: 600  
b) Private saving. Answer: 250  
c) Disposable income. Answer: 850  
d) Gross domestic product. Answer: 975  
e) Net exports. Answer: 25  
f) The current account balance. Answer: 50

**Solution**

The calculations needed to answer the above questions are listed below. The sequence of the reported calculations provides a simple way to derive all the quantities of interest.

First compute GDP. We know that the link between GDP and GNP is

\[
\text{GDP} = \text{GNP} - \text{NFP} = 1000 - 25 = 975
\]

Second, the difference between national saving and investment is equal to the current account balance

\[
\text{CA} = \text{S} - \text{I} = 200 - 150 = 50
\]

The CA balance is the sum of net exports and net factor payments. Next we compute net exports.

\[
\text{NX} = \text{CA} - \text{NFP} = 50 - 25 = 25
\]

Compute consumption by using the income-expenditure identity and the magnitude of NX derived above.

\[
\text{C} = \text{Y} - \text{I} - \text{G} - \text{NX} = 975 - 150 - 200 - 25 = 600
\]

To compute private saving, recall the equation

\[
\text{S} = \text{SG} + \text{SP}
\]
Where SG is government saving and SP is private saving. The government saving is simply equal to the negative value of government deficit (in our case $-50$).

It follows

\[ SP = S - SG = S -(-Def) = S + Def = 200 + 50 = 250 \]

The last remaining quantity to compute is disposable income. To compute it use the following identities

\[ Y+NFP=GNP \]

where Y is GDP. Further

\[ TR+INT+G-T = Def \]

where Def is government budget deficit. The disposable income is equal to (by definition)

\[ \text{disposable income} = Y + NFP + TR + INT - T \]

Add and subtract government expenditures $G$ from the above expression to get

\[ \text{disposable income} = (Y + NFP) + (TR + INT + G - T) - G \]

Using the definitions of GNP and the government budget deficit we get

\[ \text{disposable income} = GNP + Def - G \]

Inserting the numbers we know from above gives the disposable income

\[ \text{disposable income} = GNP + Def - G = 1000 + 50 - 200 = 850 \]