Chapter 2 (and a bit more): Measuring Output, Prices, and Interest Rates

I. Overview – the definition and measurement of key macroeconomic variables.

   A. The economy’s output – GDP (and its components).
   
   B. Inflation – different price indices.
   
   C. Unemployment.
   
   D. Interest rates – nominal, real, rates of return.

II. GDP – Gross Domestic Product

A. Definition: The total market value of all final goods and services produced within an economy in a given year.

B. Three ways to measure: income approach, expenditure approach, value added.

*** The Familiar Circular Flow Diagram ***
1. Income approach to calculating GDP

(1991 Data – amounts are in billions of dollars)

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages and Salaries</td>
<td>3457.9</td>
</tr>
<tr>
<td>Interest Income</td>
<td>448.0</td>
</tr>
<tr>
<td>Rental Income</td>
<td>68.4</td>
</tr>
<tr>
<td>Business Profits</td>
<td>745.4</td>
</tr>
<tr>
<td>National Income</td>
<td>4719.7</td>
</tr>
<tr>
<td>Indirect taxes and transfers</td>
<td>489.6</td>
</tr>
<tr>
<td>Net National Product</td>
<td>5209.3</td>
</tr>
<tr>
<td>Depreciation</td>
<td>723.1</td>
</tr>
<tr>
<td>Gross National Product</td>
<td>5932.4</td>
</tr>
<tr>
<td>Net Income Payments</td>
<td>-15.7</td>
</tr>
<tr>
<td>Abroad</td>
<td></td>
</tr>
<tr>
<td>Gross Domestic Product</td>
<td>5916.7</td>
</tr>
</tbody>
</table>

GNP – income produced by citizens of country.

GDP – income produced within nation’s borders.

GDP = GNP – income earned by US citizens abroad + income earned by foreign residents’ earnings from home production.

2. Expenditure approach – Table 1.1 from National Income and Product Accounts

<table>
<thead>
<tr>
<th></th>
<th>Buy</th>
<th>Sell</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Miller</td>
<td>0.50</td>
<td>0.75</td>
<td>0.25</td>
</tr>
<tr>
<td>Baker</td>
<td>0.75</td>
<td>1.25</td>
<td>0.50</td>
</tr>
<tr>
<td>Store</td>
<td>1.25</td>
<td>2.50</td>
<td>1.25</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td><strong>2.50</strong></td>
</tr>
</tbody>
</table>

4. Problems with GDP as a measure of output.

1. Non-market production is not measured (household production).
2. Illegal activities are not measured.
3. Externalities (either good or bad) are not measured.
4. Since it is a dollar value – it includes changes in prices as well as output.
III. Measuring Real GDP and Inflation

If there were only one good in the world, anchovies, then data and prices would determine real output and inflation perfectly:

\[ GDP_t = P_t Q_t; \quad GDP_{t+1} = P_{t+1} Q_{t+1}. \]

Then, the growth rate of GDP, \( \lambda \), is determined by:

\[
1 + \lambda = \frac{GDP_{t+1}}{GDP_t} = \frac{P_{t+1} Q_{t+1}}{P_t Q_t} = \left(1 + \pi\right) \left(1 + \gamma\right)
\]

When more than one good, quantities and prices of each good are changing at different rates – trying to reduce multidimensional problem to one dimension.

Solution: Use price and quantity indices.
Calculation of Real GDP – Chain weighted calculation.

Use both present and preceding year prices to measure value of output.

Example:

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity</th>
<th>Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anchovies</td>
<td>Beer</td>
</tr>
<tr>
<td>1997</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>1998</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

\[
GDP_{97} = 67.145; \quad GDP_{98} = 175 \Rightarrow 1 + \lambda = \frac{75}{45} = 1.67
\]

To measure change in output, hold prices constant:

GDP in 98 at 97 prices: \(50 + 15 = 65 \Rightarrow (1 + \tilde{\gamma}) = \frac{65}{45} = 1.44\)

GDP in 97 at 98 prices: \(48 + 5 = 53 \Rightarrow (1 + \tilde{\gamma}) = \frac{75}{53} = 1.415\)

True growth of real GDP is the geometric average of the two calculations:

\[
(1 + \gamma) = \left[ (1 + \tilde{\gamma}) (1 + \tilde{\gamma}) \right]^{0.5} = \sqrt{(1.44)(1.415)} = 1.43
\]

Since the growth of nominal GDP is due to real growth and inflation, the inflation rate is determined by:

\[
1 + \pi = \frac{1 + \lambda}{1 + \gamma} = \frac{1.67}{1.43} = 1.16
\]

(Prove this is true by constructing a chain-weighted price index.)
The other major type of price index – a fixed basket price index – Consumer Price Index (CPI)

Answers the question – how much would it cost to buy basket of goods at current prices?

Let the base year be denoted \( t \), then the CPI in year \( t+1 \) is:

\[
CPI_{t+1} = \frac{\sum_{i=1}^{n} p_{i,t+1} q_{i,t}}{\sum_{i=1}^{n} p_{i,t} q_{i,t}}
\]

Discussion:

1. GDP deflator is a broad based index. The implied inflation rate may not be relevant for households.

2. CPI overstates inflation since it does not permit substitution out of expensive goods. Recent commission chaired by Michael Boskin estimated that CPI overstates inflation rate by 1% per year. This is not a trivial number since cost of living adjustments for Social Security and other transfer programs are tied to this – over the next decade the govt. would save $634 billion dollars.

3. Both indices do not adjust for quality changes. However, since chain weighted indices compare adjacent years, not too big of a problem.

4. Chain weighted indices are expensive to construct – need annual data on prices and quantities.
IV. Measuring Unemployment

<table>
<thead>
<tr>
<th>Working Age Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployed ((U))</td>
</tr>
<tr>
<td>Employed ((E))</td>
</tr>
<tr>
<td>Not in Labor Force</td>
</tr>
</tbody>
</table>

Labor Force \((LF) = U + E\)

Unemployment Rate: \(u = \frac{U}{LF}\).
V. Interest Rates

There are many different types of interest rates – the interest rate on a bond is defined as the *yield to maturity*. Bonds are differentiated by (1) the issuer and (2) maturity. We shall be interested primarily in:

Government securities:

- Discount Rate – the rate the Fed charges on overnight loans.
- Treasury Bills ($0 < M \leq 1$), Notes ($2 \leq M \leq 10$), Bonds ($M > 10$).

Interest rates tend to move together – but not always. This was instrumental in the much publicized problems with *Long Term Capital Management*.

**Difference between nominal and real interest rates**

All bonds are expressed in dollar terms – the yields are *nominal*. You give up current dollars for the promise of dollars in the future.

$$1 + n = \frac{\$(1 + n)_{t+1}}{\$1_t}$$

The *real interest rate*, $r$, is denominated in terms of goods. Then, for the above bond, the associated real interest rate is:

$$1 + r = \frac{\frac{P_{t+1}}{P_t}}{(1 + n)\frac{P_t}{P_{t+1}}} = \frac{1 + n}{1 + \pi}$$

Or, approximately: $n = r + \pi$.

If inflation is uncertain: $n = r + \pi^e$. (This is the **Fisher relation**).