

## Macroeconomics, Module 11: Capital Utilization and Unemployment

### *Homework Assignment: Seasonal Unemployment Rates*

(The attached PDF file has better formatting.)

Unemployment is cyclical. The commonly-used unemployment rate is seasonally adjusted, so the cyclical pattern is not obvious.

Retail firms for *non-essential* goods often have higher sales in the fourth quarter of the year. For example:

- Sales of groceries and other essential items do not vary by quarter.
- Sales of children's toys, stereos, and theater tickets vary by quarter.

The job finding rate is high in November and December, as stores hire retail clerks and sales persons, and the job separation rate is low, since stores want to keep experienced workers.

For this homework assignment, assume that *job finding and separation occur at the beginning of the quarter: January 1, April 1, July 1, and October 1.*

- In quarters 1, 2, 3, the job separation rate = 5% and the job finding rate = 20%.
- In quarter 4, the job separation rate = 2% and the job finding rate = 80%.

We determine the *seasonal pattern* of the natural unemployment rate.

- A. What is the natural unemployment rate in each quarter of the year?
- B. What is the average natural unemployment rate? This is the seasonally adjusted natural unemployment rate.

The natural unemployment rate differs for each quarter. To solve this homework assignment, use the following steps.

Let  $U$  be the natural unemployment rate for December 31, so the natural *employment* rate on December 31 is  $1 - U$ .  $U$  is the natural unemployment rate for the entire fourth quarter, since all hiring and separation occurs on the first day of the quarter.

We move forward one quarter.

- The unemployed persons hired in the first quarter are  $U \times 20\%$ .
- The employed persons leaving jobs in the first quarter are  $(1 - U) \times 5\%$ .
- The natural unemployment rate in the first quarter is  $U - U \times 20\% + (1 - U) \times 5\% = U \times 75\% + 5\% = 0.75U + 0.05$ .
- The natural employment rate in the first quarter is  $1 - 0.75U + 0.05 = 0.95 - 0.75U$ .

We move forward another quarter.

- The unemployed persons hired in the second quarter are  $(0.75U + 0.05) \times 20\%$ .
- The employed persons leaving jobs in the second quarter are  $(0.95 - 0.75U) \times 5\%$ .
- The natural unemployment rate in the second quarter is  $(0.75U + 0.05) - (0.75U + 0.05) \times 20\% + (0.95 - 0.75U) \times 5\%$ . Simplify this expression.

Continue in this fashion for all four quarters of the year. Remember that the job separation and finding rates differ for the fourth quarter.

Derive the natural unemployment rate in the fourth quarter of the year. All years are alike, so this expression equals  $U$ . Solve for  $U$ , the natural unemployment rate in the fourth quarter.

Use the expressions for the natural unemployment rate in the other quarters to get the natural unemployment rate in each quarter of the year.

*Note:* The pattern in this homework assignment is a sharp spike in employment for the fourth quarter and a gradual decline over the next three quarters. The cyclical pattern of the natural unemployment rate can take two forms.

- If firms hire temporary workers, they hire workers on October 1 for three months only. The number of workers employed drops as soon as demand for these workers declines. This is characteristic of agricultural workers and some low paid clerical workers.
- If firms hire permanent workers, they can increase employment rapidly, but employment drops slowly when demand decreases. Construction work has this characteristic. In prosperous times, demand for new housing is strong, and new workers are hired. As the economy slows, demand drops. Some workers are laid off, and few workers are hired.

*Note:* The unemployment rate is highly cyclical. Agricultural work and outdoor construction work are plentiful in the spring and summer and scarce in the winter. High school and college students often look for work in the summer months, so the labor force increases during the summer. Each industry has its own seasonal employment pattern.

To check your work, verify that the unemployment rate in the fourth quarter is the same as the unemployment rate one year earlier. Use the Excel *SOLVER* built-in function. The attached Excel spread-sheet shows how to check your results.

Column B is the unemployment rate and Column C is the employment rate. The rows of the worksheet are the quarters. Start with Row 2 as the fourth quarter of last year.

Choose any unemployment rate for the fourth quarter of last year. Put that rate in Cell B2.

Column C is the employment rate. In Cell C2, put the formula: “= 1 - B2” Copy this formula to Cells C3, C4, and C5.

Column D is the job finding rate and column E is the job separation rate.

- Put 0.2 in Cell D2 and copy this cell to cells D3, D4. Put 0.8 in Cell E5. In this simplified exercise, the job finding and separation rates apply at the end of the quarter, giving the

employment and unemployment rates in the next quarter.

- Put 0.05 in Cell E2 and copy this cell to cells E3, E4. Put 0.02 in Cell E5.

Cell B3 is the unemployment rate for the first quarter. In Cell B3, put the formula: “=B2 \* (1 - D2) + C2 \* E2” Copy this formula to cells B4, B5, and B6. In words: the unemployment rate next quarter is the unemployed workers in the previous quarter who did not find jobs plus the employed workers who were laid off.

Cell B7 is the average unemployment rate, or the seasonally adjusted natural unemployment rate. Put the formula =*AVERAGE*(B3 : B6). We are assuming that the labor force does not change over the year.

In Cell B8, put the formula =B6 – B2. These are the same quarter in two successive years. In a steady state, the unemployment rates are the same.

Save your work-sheet before running solver. Open the *TOOLS* menu and chooser *SOLVER*.

Your cursor may be anywhere in the worksheet. On the screen, choose “set cell B8 equal to zero” by choosing values in Cell B2. Press enter. Solver will find the value for Cell B2 which causes Cell B8 to be zero. Different releases of Excel has different ways to invoke *SOLVER*. Use the Excel help facility for exact instructions.

This should be the same value that you get by solving the linear equation. You can also use *GOAL-SEEK* to solve this problem, but *SOLVER* is a more general method.

The attached spread-sheet starts with too high an unemployment rate for Cell B2. (If the Excel spread-sheet gave the solution, the homework assignment would be too easy.) Use *SOLVER* to find the natural unemployment rate. The spread-sheet has the correct cell formulas, but you must solve for the natural unemployment rate.

Many macroeconomic problems solve for an equilibrium. You can solve for the steady state income level using the Solow growth model with *SOLVER* as well.