

Econ 100B: Economic Analysis – Macroeconomics
Problem Set #7 – Solutions
Due Date: October 23, 2020

General Instructions:

- Please upload a PDF of your problem set to Gradescope by 11:00 pm.
- **Late homework will not be accepted.**
- Please put your name and student ID at the upper right corner of the front page.

1. Review the recent [FOMC statement](#) and answer the following questions:

(a) What are the Committee's employment and price goals?

Solution: " ... maximum employment and price stability."

(b) What is the Committee's target range for the federal funds rate?

Solution: 0 to 1/4 percent.

(c) What is the Committee's longer-run inflation goal?

Solution: 2 percent.

(d) Did all FOMC members vote for the monetary policy action? If not, who dissented and what was their policy proposal?

Solution: No.

Robert S. Kaplan dissented with the proposal that "it will be appropriate to maintain the current target range until the Committee is confident that the economy has weathered recent events and is on track to achieve its maximum employment and price stability goals as articulated in its new policy strategy statement, but prefers that the Committee retain greater policy rate flexibility beyond that point."

Also dissenting was Neel Kashkari, "who prefers that the Committee indicate that it expects to maintain the current target range until core inflation has reached 2 percent on a sustained basis."

2. Use Okun's law to ...

- (a) ...rewrite the central bank loss function in a way that better reflects the dual mandate of the Federal Reserve in terms of unemployment and inflation, and ...

Solution: The central bank loss function

$$L = (Y_t - Y_t^P)^2 + \beta (\pi_t - \pi^T)^2 \quad (1)$$

expresses loss as a function of the output gap and the inflation gap. While the inflation gap is closely related to price stability, the output gap is less closely related to maximum employment. To bring maximum employment (or minimum unemployment) into the loss function, we can use Okun's law

$$(U_t - U_N) = C_{\text{Okun}} (Y_t - Y_t^P) \quad (2)$$

to replace the output gap with the unemployment gap. Rewriting Okun's law as

$$(Y_t - Y_t^P) = \frac{1}{C_{\text{Okun}}} (U_t - U_N) \quad (3)$$

and substituting this into the loss function gives

$$L = \left(\frac{1}{C_{\text{Okun}}} (U_t - U_N) \right)^2 + \beta (\pi_t - \pi^T)^2 \quad (4)$$

or

$$L = \frac{1}{C_{\text{Okun}}^2} (U_t - U_N)^2 + \beta (\pi_t - \pi^T)^2 \quad (5)$$

which, by expressing loss as a function of the unemployment gap and the inflation gap, better reflects the dual mandate of the Federal Reserve.

- (b) ...then determine the value of β in the central bank loss function that would result in an equal weighting of the two terms in the dual mandate of the Federal Reserve.

Solution: For the terms in the loss function to have equal weight the coefficients on each gap would need to be the same, so

$$\beta = \frac{1}{C_{\text{Okun}}^2} = \frac{1}{(-0.63)^2} = 2.52 \quad (6)$$

where $C_{\text{Okun}} = -0.63$ comes from our empirical work on the U.S. version of Okun's law in problem set 6.

3. Referring to *China unexpectedly cuts reverse repo rate by most in 5 years to support virus-hit economy*:

- (a) Given the change in the reverse-repo rate discussed in the article how many basis points are in one percent?

Solution: The article begins with the following 2 bullet points:

- China's central bank unexpectedly cut the rate on reverse repurchase agreements by 20 basis points on Monday, the largest in nearly five years, as authorities stepped up measures to relieve pressure on an economy ravaged by coronavirus pandemic.
- The People's Bank of China (PBOC) said on its website that it was lowering the 7-day reverse repo rate to 2.20% from 2.40%.

From this we see that the change from 2.40% to 2.20% is 20 basis points. This 0.2% is the same as 20 basis points and it follows that there are 100 basis points in one percent.

- (b) What was the term (number of days) of the reverse-repo rate that the PBOC changed.

Solution: From the second bullet point we see that the term of the reverse-repo was 7 days.

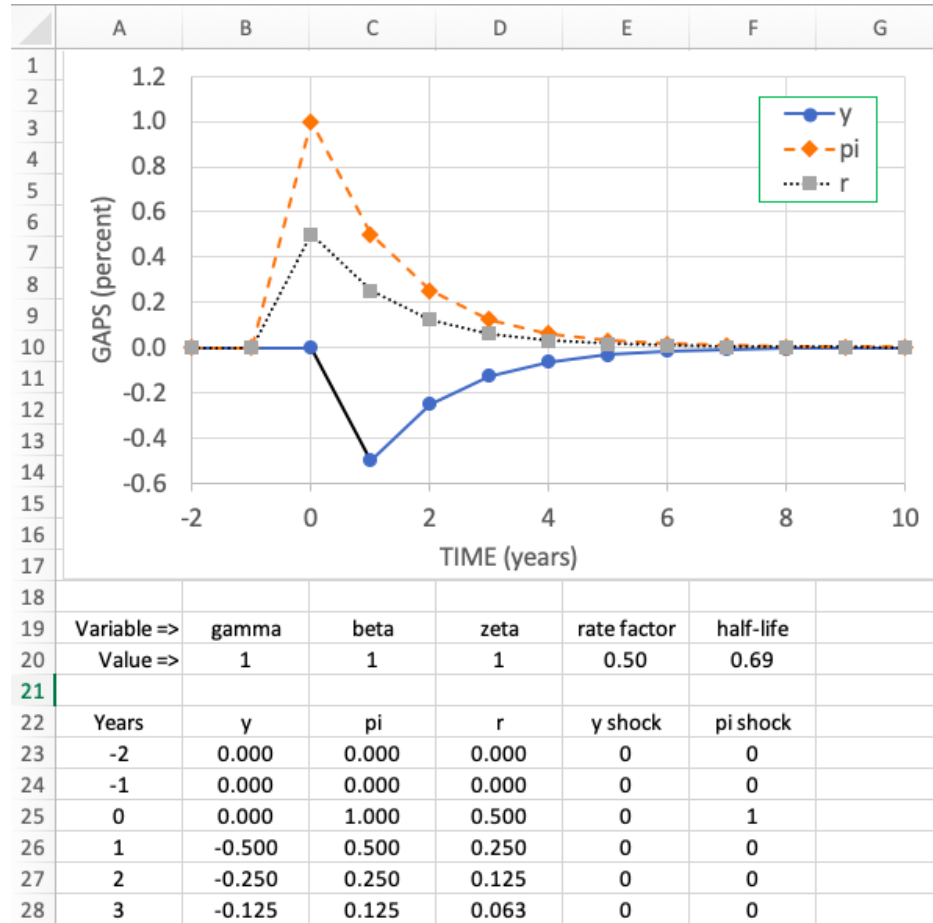
- (c) A change in the policy rate can be categorized via the optimal rat rule in terms the change in inflation as follows:

- *expansionary* if the new rate is lower than what the change in inflation indicated.
- *contractionary* if the new rate is higher than what the change in inflation indicated.
- *neither expansionary or contractionary* if the new rate is what the change in inflation indicated.

If there was no change in inflation when the PBOC changed the reverse-repo rate, was their action expansionary, contractionary, or neither? Briefly explain.

Solution: If the interest rate was lowered when there was no change in inflation, then this monetary policy action would be categorized as expansionary.

4. We will now build a monetary policy calculator using the update algorithm implied by the dynamic IS curve and the Phillips curve. An example of my Excel version of this calculator is shown below. This example was used to generate the graph on slide 5 of lecture 13. You can use your preferred platform (e.g., Python, Matlab, Octave, Mathematica, etc.), but the steps presented below will be given in terms of Excel.



In this simulation we will be evolving the values of the output gap $\tilde{y}_t$, the inflation gap $\tilde{\pi}_t$, and the rate gap $\tilde{r}_t$.

- (a) The variables and their values for the simulation are shown in rows 19 and 20. The rate factor is

$$\frac{1}{\zeta_y \left(\gamma + \frac{1}{\gamma\beta} \right)}$$

which, since we will be using it a lot and it does not change with time, we calculate once here. We also calculate the half-life just to have it around. The half-life is not an input to the simulation.

- (b) Add the headings shown in row 22.

- (c) Populate the years shown in column A.
- (d) Populate the shocks shown in columns E and F. Note the value of “1” for the inflation shock at year 0.
- (e) Set the values of $\tilde{y}_t$, $\tilde{\pi}_t$, and $\tilde{r}_t$ in year -2 (row 23) to zero.
- (f) The evolution of $\tilde{y}_t$ and $\tilde{\pi}_t$ from $t = -2$ to $t = -1$ is accomplished as follows:
 - The output gap $\tilde{y}_t$ evolves according to the gap form of the dynamic IS curve:

$$\tilde{y}_t = -\zeta_y \tilde{r}_{t-1}$$

so

$$\tilde{y}_{-1} = -\zeta_y \tilde{r}_{-2} .$$

To this we add the possibility of a shock to $\tilde{y}_{-1}$ indicated in column E. Adding this term, the complete update—IS curve and shock—is given by

$$\text{B24} = -\$D\$20*\text{D23} + \text{E24} .$$

- The inflation gap $\tilde{\pi}_t$ evolves according to the gap form of the Phillips curve:

$$\tilde{\pi}_t = \tilde{\pi}_{t-1} + \gamma \tilde{y}_t$$

so

$$\tilde{\pi}_{-1} = \tilde{\pi}_{-2} + \gamma \tilde{y}_{-1} .$$

To this we add the possibility of a shock to $\tilde{\pi}_{-1}$ indicated in column F. Adding this term, the complete update—Phillips curve and shock—is given by

$$\text{C24} = \text{C23} + \$B\$20*\text{B24} + \text{F24} .$$

- The rate gap $\tilde{r}_t$ is set by the central bank in response to the value of the inflation gap $\tilde{\pi}_t$ using the gap form of the optimal rate rule:

$$\tilde{r}_t = \frac{1}{\zeta_y \left(\gamma + \frac{1}{\gamma^\beta} \right)} \tilde{\pi}_t$$

so

$$\tilde{r}_{-1} = \frac{1}{\zeta_y \left(\gamma + \frac{1}{\gamma^\beta} \right)} \tilde{\pi}_{-1} .$$

Since there is no shock to the rate because the central bank is setting the rate, the update to the rate $\tilde{r}_{-1}$ is given by

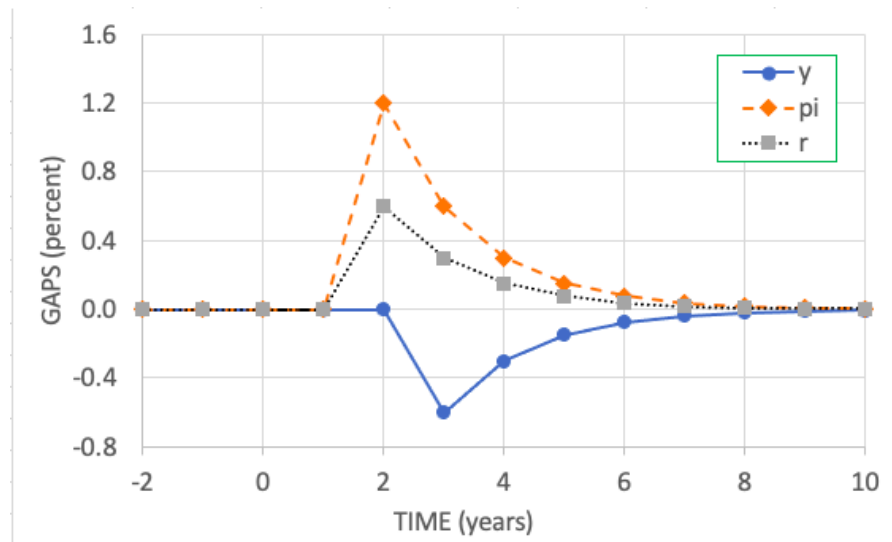
$$\text{D24} = \$E\$20*\text{C24} .$$

- (g) The evolution for all future time ($t > -1$) is the same. If you copy the equations in cells B24, C24, and D24 down for the remaining times given in column A you should see the results shown in the figure.

- (h) You can check that your calculator is working properly (i.e., validate it) by reproducing the gap graph shown on slide 5 of lecture 13.

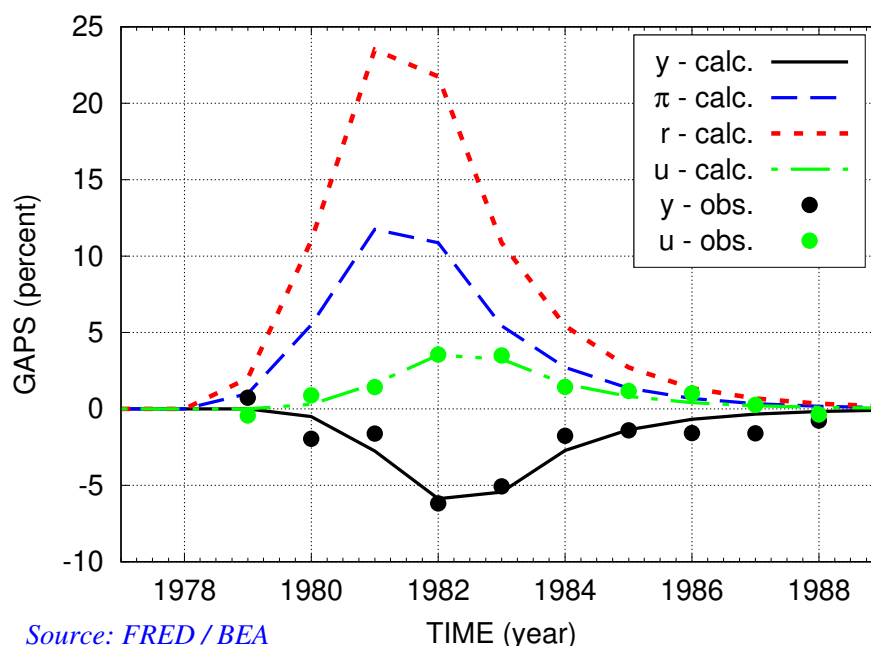
Your submission for this question should be a screenshot of your calculator showing your calculated results for a single inflation shock of size 1.2 at $t = 2$ years.

Solution: Your graph should look like the one shown below.



The maximum of the inflation shock of 0.8 is seen at the 2 year point.

5. We will now use the calculator to study the gap changes in the 1980s associated with the Federal Reserve's response to inflation under then Chair Paul Volker.



I used an inflation shock based on a change in the inflation target of the Fed. In the graph “calc” means calculated and “obs.” means observed. My approach to this analysis is as follows:

- Add a column to calculate the unemployment gap from the output gap using Okun's law. This is useful because data for the unemployment gap is more common than is data for the output gap.
- Get annual data from FRED to calculate the output and unemployment gaps. This will be just like your Okun's law data retrieval, but with annual data instead of quarterly data.
- I started a shock sequence at model time $t = 0$ and aligned that with actual time $t = 1979$. The model coefficients were set to $\beta = 1$, $\gamma = 1$, and $\zeta_y = 0.25$.

Your submission for this question should be a screenshot of your calculator showing your calculated version of the graph above together with a brief discussion of (i) your shock sequence, (ii) the fit to the unemployment and output gaps, and (iii) the resulting rate and inflation gaps.

Solution: *Note: Your shock sequence will almost certainly be different from mine since you were free to generate the fit that looked best to you. Also, is it not*

necessary to get the calculated gaps to go through every observed-gap data point. It is often true that “less is better” when fitting theory to data. The shock sequence I used to generate the results shown above is 1, 5, 9, 5 with the first shock in 1979 and the last shock in 1982. These inflation shocks would correspond to decreases in target inflation by the Federal Reserve. The small values of the output and unemployment gaps in 1979 and in the late 1980s suggests that the U.S. economy went from one steady state to another. The rise in the inflation gap during this time reflects the drop in the target inflation rate and the subsequent closing of the inflation gap the approach of inflation to the new, much lower, target inflation. The decrease in the target inflation rate required similarly substantial increase in the real rate gap, consistent both with the high Fed Funds rate seen during that time.