ECOM021 Group Project: Real Business Cycle Model

# **Question 2:**

# 2a)

## U.S. Business Cycle Statistics (Topic 4 – Table 14.2)

Standard Deviation of Y: 1.81

Standard Deviation of C relative to standard deviation of Y: 0.74

Standard Deviation of I relative to standard deviation of Y: 2.93

Correlation of Y and r: -0.35

Correlation of Y and w: 0.12

## A screenshot of a computer Description automatically generated

## Our results:

Note: These results vary between the Excel file and Python file – This is due to the randomness generated in the error term.

**Standard Deviation** **of Y:** 0.671

Our model differs from the moments in Table 14.2. The standard deviation of output is high in Table 14.2 (1.81), suggesting that output data points have a large dispersion from the mean. Meanwhile, our figure (0.671) is roughly a third than that in Table 14.2. This suggests that our data points are far more clustered around the mean. This difference could be due to the figures from Table 14.2 involving real data, whereas we have only generated data.

**Standard Deviation of C relative to Standard Deviation of Y**: 0.853

In our findings, the relative standard deviation of consumption is 0.853, whereas Table 14.2 shows a smaller value (0.74). The fact that our figure exceeds that of Table 14.2 implies that changes in output have a slightly larger effect on consumption than that in Table 14.2. This might suggest that individuals within our model are more responsive to short-term economic fluctuations and adjust their consumption levels more significantly in response to these.

**Standard Deviation of I relative to Standard Deviation of Y:** 1.706

Investment within an economy is known to be highly volatile as investments are made for purely profitable gain and based on confidence. As a result, when economic fluctuations occur, investment follows the same direction of the economy, but with greater magnitudes. Our model shows that the standard deviation of investment relative to the standard deviation of output is 1.706, which is lower than that in Table 14.2 (2.93). Despite its lower value, both results suggest that investment is far more volatile than output.

### Plot 1: Output, Consumption and Investment Over Time

**A graph with green and blue lines

Description automatically generated**

Plot 1 depicts Output, Consumption and Investment over time. This helps to visualise the results from our simulation. Here we can see much larger deviations in investment over time compared to output. Therefore, just by looking at the graph, we know that the relative standard deviation for investment will be above 1 (1.706). In addition, the lines for consumption and output closely align, with output exhibiting slightly larger deviations. Thus, we can infer that the relative standard deviation of consumption will be below 1, but still high (0.853).

**Correlation of Y and r:** -0.063

The value of -0.063 suggests a very weak, negative correlation (almost no correlation) between the interest rate and output. This is depicted in plot 2 - the plot of output, interest rate and wage over time. In contrast, Table 14.2 indicates that there is a negative relationship between interest rate and output, with a correlation value of -0.35.

The negative correlation observed between output and interest rates may be due to a monetary response lag. This lag refers to the time it takes for the Central Bank to adjust interest rates to mitigate inflationary pressures. During these lag periods, the influence of the economic shock on output may be mitigated by various factors, such as fiscal policy and conditions in financial markets. Consequently, adjusting interest rates may not be optimally timed after the lag, and decision-making becomes more complex, particularly in the face of multiple shocks occurring over time.

**Correlation of Y and w**: 1

The value of 1 suggests a perfect correlation between output and wage, as the equations for Y(hat) and W(hat) are identical. The reason is households do not derive utility from leisure in our model, leading to n = 1 and L = 0. This explains why our value is different from the result of the U.S. business cycle statistics (0.12) - where households would derive utility from leisure.

### Plot 2: Output, Interest Rate and Wage Over Time

A graph showing a line of green and orange lines

Description automatically generated with medium confidence

Plot 2 illustrates output, interest rate and wage over time. We can see that there is no clear pattern in the movement of 2 lines: output and interest rate, which explains why their correlation is very weak (-0.063). Furthermore, the lines for output and wage are similar, so the correlation between them is equal to 1.

# 2b)

### A graph with a line Description automatically generatedPlot 3: Positive TFP Shock Impulse Response Functions

A graph of a graph

Description automatically generated with medium confidence

# 2c)

### Plot 4: Negative TFP Shock Impulse Response Functions

A graph with a curve

Description automatically generated

A graph with a line

Description automatically generated

According to impulse response functions in plot 3 and plot 4, the response to the positive and negative shocks is symmetric. The symmetry is demonstrated by the fact that the magnitude of the shock is the same regardless of its sign. Although positive and negative shocks have opposite effects, they influence the economy to the same extent: equal response time, the same severity of the shock, and similar time to bring the economy back to its steady state.

A positive technology shock, characterised by an increase in total factor productivity (TFP) in the RBC model, creates an economic boom. This is where the economy operates above its potential level. In contrast, the recession occurs due to a negative technology shock, where again, it is represented by a decrease in TFP. It has the opposite effect of a boom and causes the economy to operate below its potential level. However, both shocks are only temporary and over time, the economy will return to the steady state.

In our model, recessions are not more severe or abrupt than expansions. Because the shock’s magnitude is the same (1 standard deviation TFP shock), both recessions and booms are equal in abruptness and severity. Besides, the expansionary periods and recession periods last for an equal amount of time. Our results demonstrate that after T=300, the economy will return to the steady state in both cases. However, this might not be true in the real economy where it may take longer or quicker to recover from shocks due to a variety of factors such as the different behaviour of agents or price rigidity.