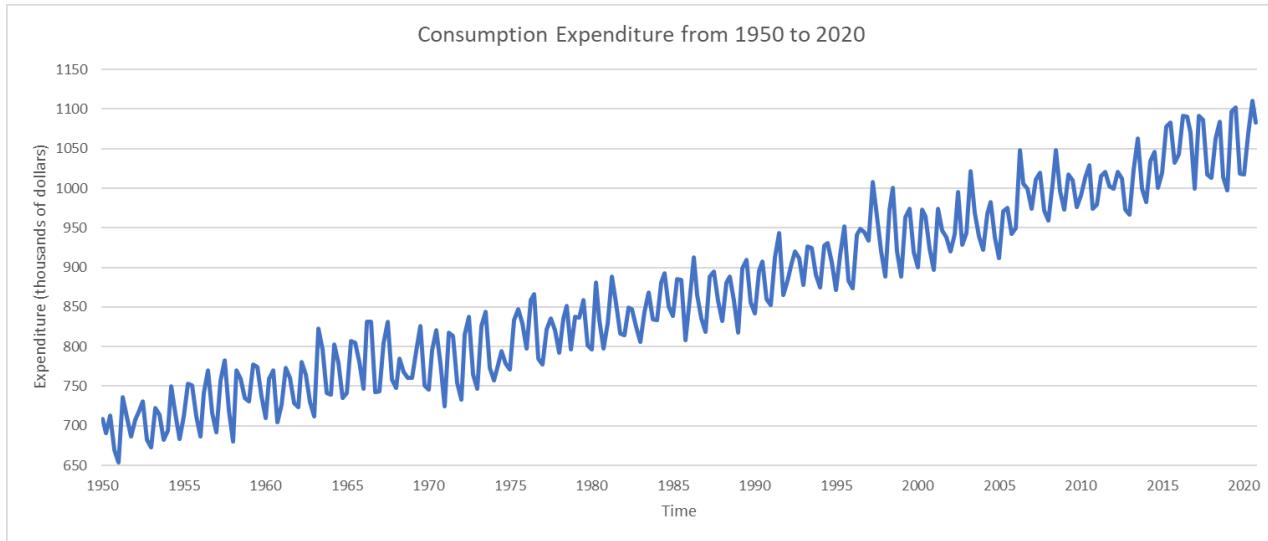
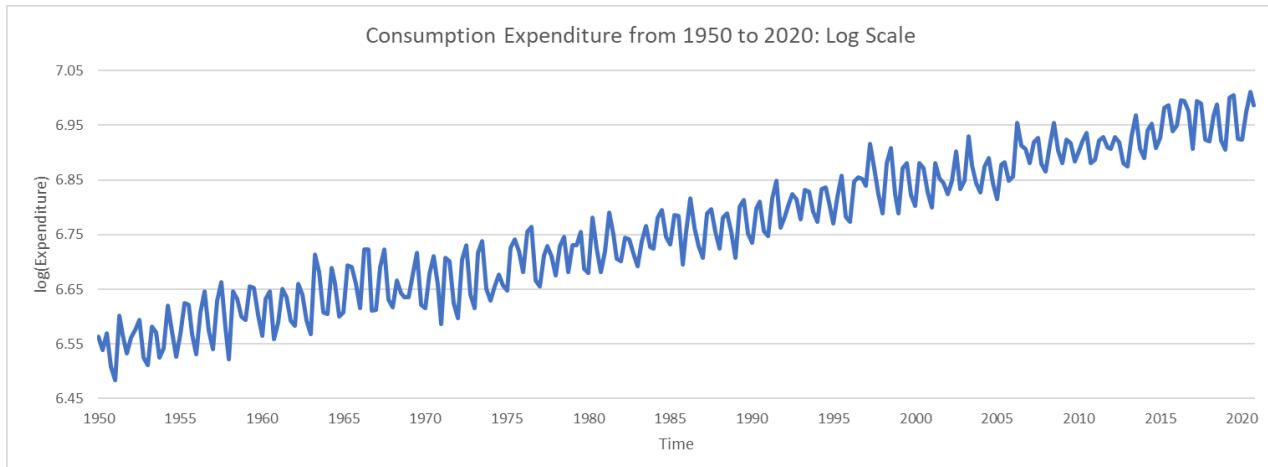


Part A: Visualization

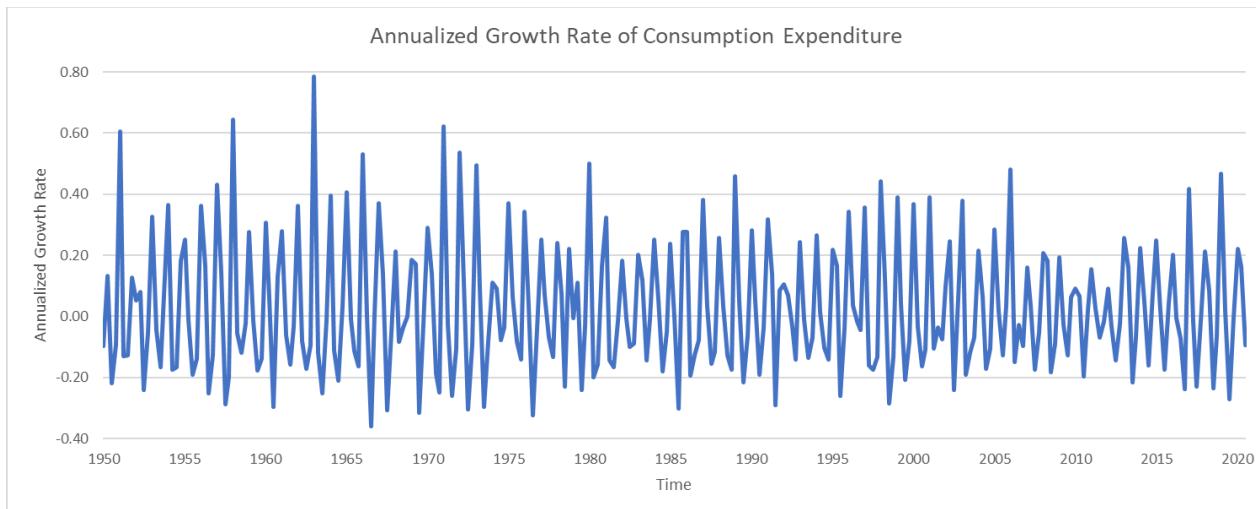
1. The consumption expenditure series shows a positive trend and has increased on average between 1950 to 2020, which is evident as expenditure began around 700 (thousands of dollars) and increased to around 1100 (thousands of dollars). Regarding annual fluctuations, most annual increases are followed by a decrease. Over slightly longer periods such as those around 1975, 1985, and 2015 have less drastic annual fluctuations such that increases/drops are smaller.



2. In the previous question, the consumption expenditure series shows a positive trend that has increased on average. This is supported by the log-scale of the series, which evidently shows the trend is linear and constant, ignoring short term fluctuations. Thus, the growth rate is constant such that consumption expenditure is increasing at an approximately constant rate.

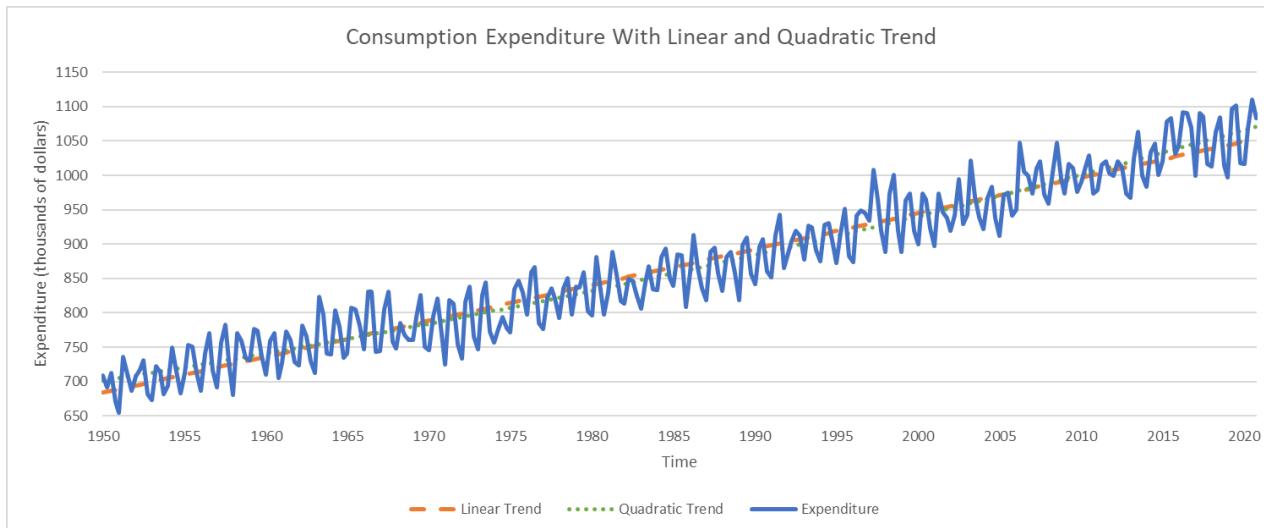


3. Similarly to the previous questions and observations, the annualized growth rate is relatively constant on average around 0.00, but with short term fluctuations ranging from around -0.40 to around 0.80. This continues to support that with a constant growth rate, consumption expenditure increases at a constant rate between 1950 to 2020.

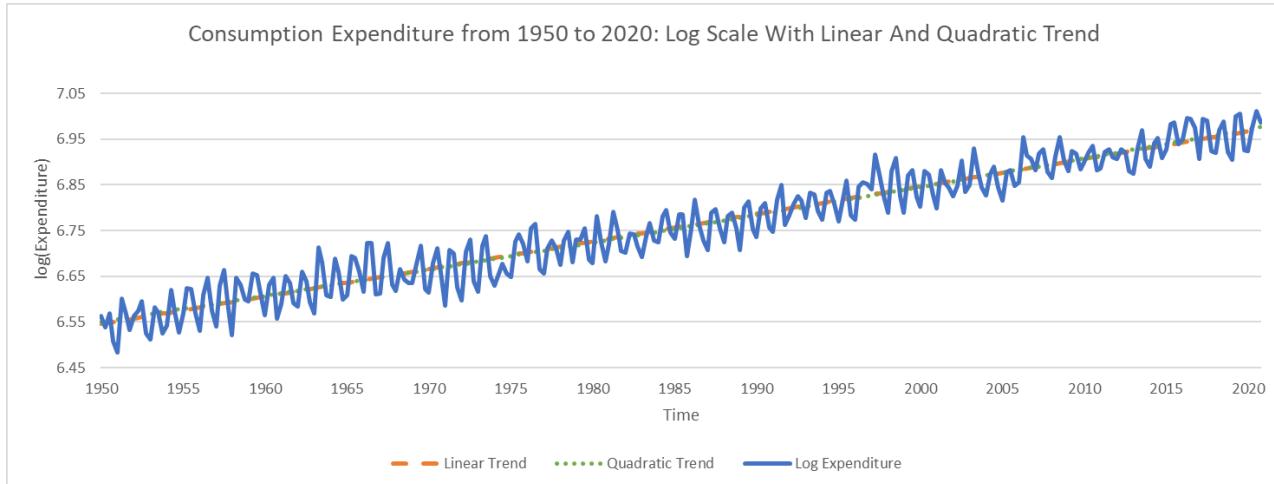


Part B: Time Series Decomposition

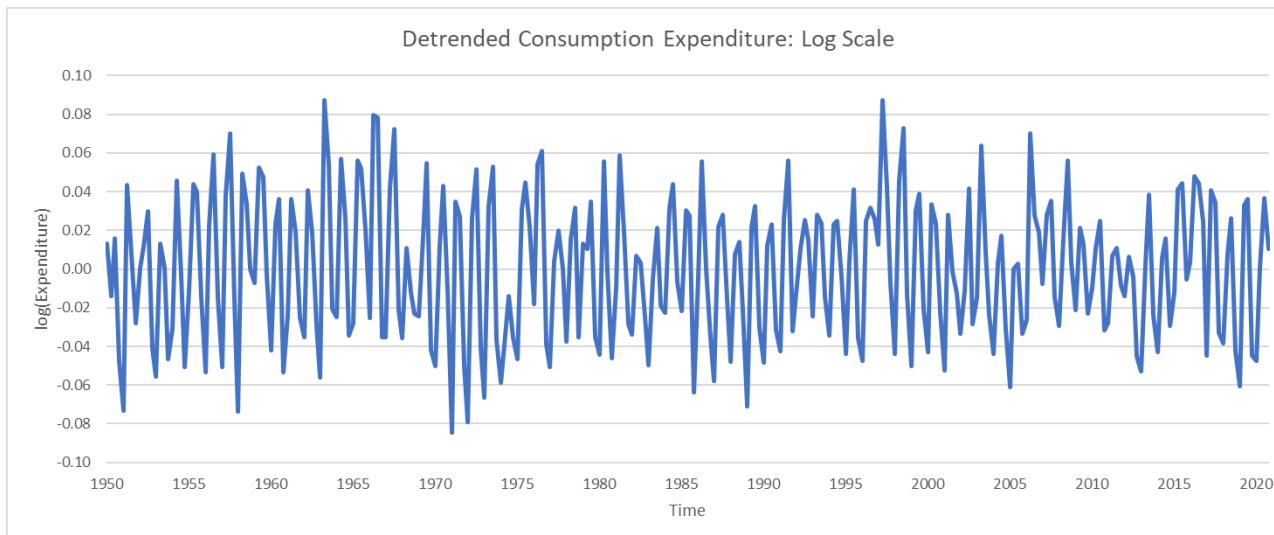
1. Of the two trends, the quadratic trend fits the data better than the linear trend. Throughout most of the consumption expenditure series, the quadratic trend does better at following the overall average with the exception of the extreme ends of the series where the linear trend seems to fit better. However, overall, the quadratic trend fits best.



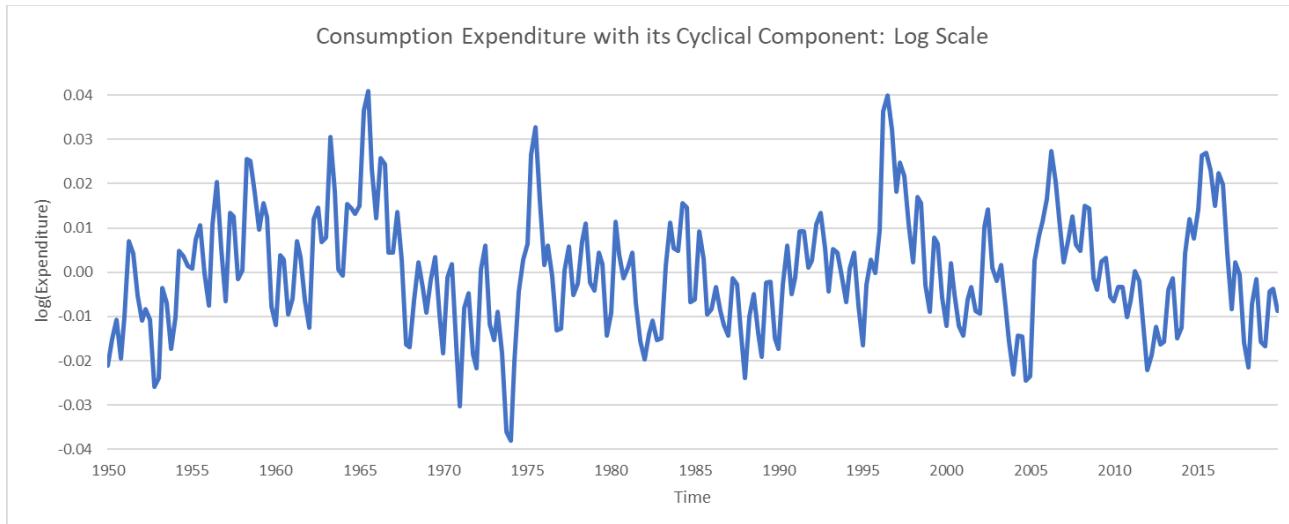
2. Interestingly, it appears that both trends adequately best fit the series, which differs from the previous question where the quadratic trend is evidently the better fit. In the previous question, both trends rarely touched/met throughout the entire consumption expenditure series, whereas when fit to the log of the series, both trends are extremely similar throughout with minor differences, such as at the extreme ends of the series.



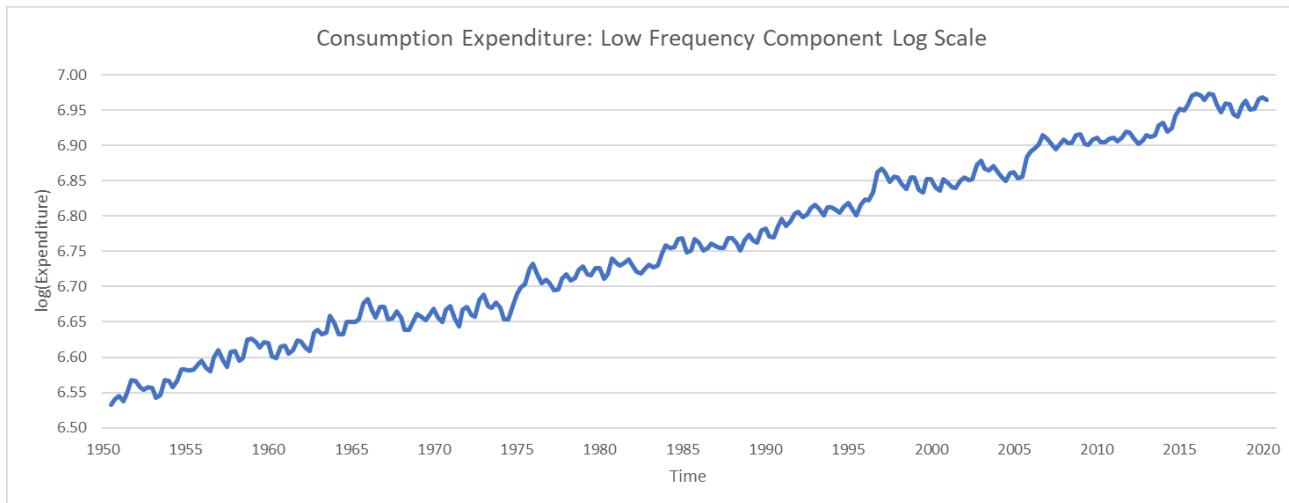
3. As a result of using the quadratic trend, there is evidence that the trend has been properly removed as the detrended series does not resemble a U-shape. Instead, it looks similar to the annualized growth rate of consumption expenditure plot that is relatively constant on average around 0.00 with short term fluctuations ranging from around -0.08 to around 0.09. Additionally, it does better detect short term fluctuations. As mentioned previously, periods around 1975, 1985, and 2015 have less drastic annual fluctuations such that increases/drops are smaller, which is clearer here with the “gaps/space” around these periods.



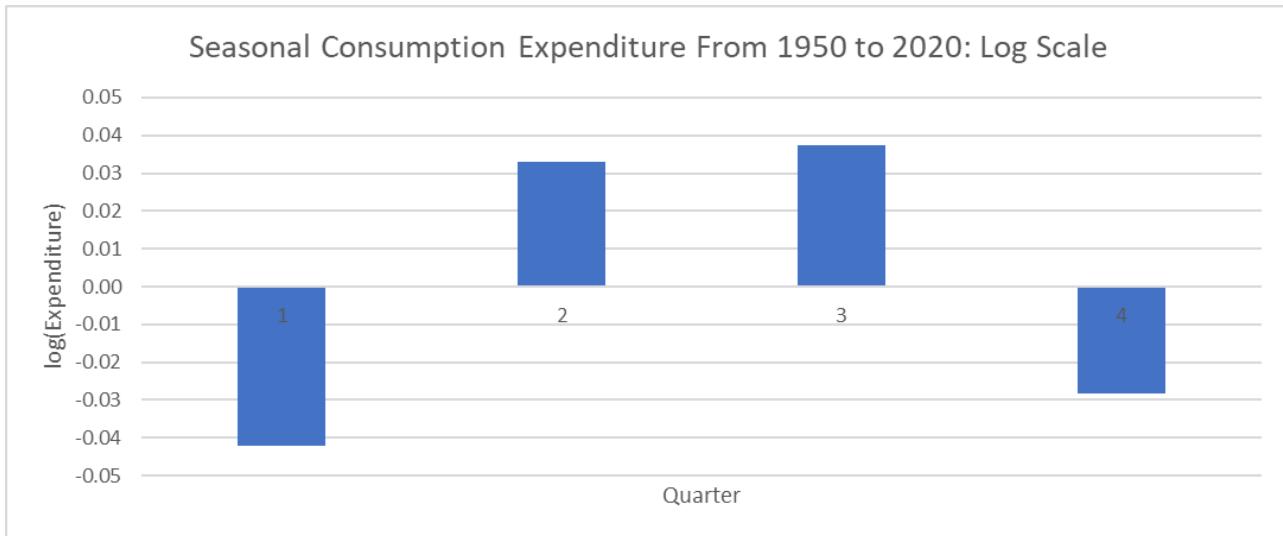
4. In the following graph, log-deviations from the trend are represented. Between 1950 to 2020, it is evident that there are many fluctuations around the trend where in this case, between 4% below (-0.04) and 4% above (0.04) the trend. Just before 1975 was when fluctuations were the lowest around the trend, whereas around 1965 was when fluctuations were the highest.



5. In comparison to the previous graph, the fluctuations around the trend are less pronounced as they are small compared to the trend scale. It has a similar shape to the consumption expenditure log scale series such that it shows a positive trend and increases, and once again, there are distinct portions amongst the series around periods like 1975 and 2015.



6. Throughout the 4 quarters from 1950 to 2020, there is an even division between quarters that are higher and lower on average from the low frequency component. In quarter 1 and 4, the consumption expenditure is 4.2% (-0.042) and 2.8% (-0.028) lower than the low frequency component on average, respectively. In comparison, the consumption expenditure in quarter 2 and 3 is 3.3% (0.033) and 3.7% (0.037) higher than the low frequency component on average.



Part C: Comovement

From the first scatter plot, it appears that there is a linear-like relationship between consumption expenditure of Data 150 and Data 45 such that high consumption expenditure from Data 150 is associated with high consumption expenditure in Data 45 due to the variables moving in a positive/the same direction on average (positive comovement). However, when supported with the second scatter plot, it is evident that the two variables are not positive/no comovement once the trend components have been removed.

