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| **ECON 102: Second Assignment** |

*Saturday, November 22, 2020*

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Dat7.csv

**Part A: The Cost of Living**

*Q1)**Plot the evolution of the hourly nominal wage for males and females on the same chart. Interpret what you see: what kind of trending behaviour, is there a difference between males and females in terms of trends or fluctuations, etc.*

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The trending behaviour is positive for both male and female hourly wages, however, this does not mean that they are equal as female nominal wages are almost always lower than male nominal wage. Only in 5 years (1997, 1999, 2004, 2006, 2014) out of 23 years is the female hourly wage greater than the male hourly wage. Across the 23 years the average nominal female wage was 13.87 which is 12% less then the average nominal male wage of the time (which is 15.87). The graph shows that for the two groups the rate of growth for support services is high.

As well we notice that the peaks of female hourly wages are often 1-2 years behind the peaks of male hourly wages. We see this as in 2006 to 2009 there is an extreme growth in male wages of 50%, the corresponding female wage growth happens in 2010 to 2011 where the rate is 21%. Its also noticeable visually that the peaks for female hourly wage are smaller than the peaks for male hourly wages. We notice that male hourly wages are more volatile whereas female hourly wages have more consistent annual growth.

*Q2)**Plot the evolution of hourly real wage in dollars of 2002 for males and females on the same chart. Interpret what you see and compare this chart with the one you obtained in the previous question. Which chart between this one and the one produced in the previous question provides a better picture of the evolution of the standard of living of individuals working in that industry? Explain.*

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The first difference that we notice is that the annual real growth of male and female wages looks positive but much flatter what the nominal graph shows. For example, we see in the years from 1997 and 2006 that the real hourly female is roughly consistent, but the nominal graph shows consistent growth during that period. As well the nominal graph shows a larger difference between annual male and female wages (1.7) then the real graph (2).

Logically and graphically, the real wage graph provides a better picture for standard of living in the service industry as it adjusts for inflation. This is important as inflation increases the price of living as well as the price of wages. This makes understanding hourly wages from the nominal graph unreliable as its hard to tell what wage growth is due to inflation.

If wage growth is due to inflation, it is an unreliable measure of standard of living as your corresponding costs (food, house, loans) will increase as well. Therefore, the real graph without inflation is a much better indicator of standard of living as it shows absolute income growth.

*Q3)**Fit a linear trend to both real wage series and plot the two trends on the same graph. Interpret what you see: is the wage gap changing on average? What is the annual change on average over that period for males and females? Discuss (Hint: To answer the question, you can look at the coefficient of time of the trend equations or compute the average of annual differences).*

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Visually we can see that the trend of male real wage is steeper then the female trend of real wage, this means that annually on average the male income in the support service industry will grow at a larger rate then the female income in the support service industry. In the data this is shown as real wages for men grow at an average rate of 0.34 annually whereas the real wages for women grow at an average rate of 0.28 annually

We also see that linear trend of female wages starts at a lower point (8.8) than the male trend’s starting point (9.8). This means that on average in 1997 females make 10% less then what their male counter part makes in the support service industry. Because the male trend grows faster on average then the female trend the gap between them has gotten larger. The women trend ends in 2019 with a real average hourly wage of 14.93 where as men end with a real average of 17.38, this results in the gap widening to the point where in 2019 females make 18% of what their male counterparts make in the same industry

*Q4)*Detrend the real wage series using the linear trends computed in the previous question. Since the series are annual, the detrended series are the cyclical components. Using a scatter plot, analyze the co-movement between the two cyclical components. Try to explain your results: e.g. why there is a positive, negative or no co-movement between the two variables?

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We do not notice a notice any co-movement between the variables, this is because no matter how the cyclical component of female real hourly wages changes the corresponding cyclical component of male real hourly wages shows no constant change. We can see this visually as the corresponding y value simply fluctuates and shows no real trend as we increase along the x value.

We can also see that if we take the average of the y values (Female Cyclical Component) for the corresponding 5 smallest x values (Male Cyclical Component) we get 0.57 and if we take the y values (Female Cyclical Component) for the 5 largest x values (Male Cyclical Component) we get 0.03. This should mean that there should be a negative co movement, but from the graph this is not clear as we see the largest peaks happening when the female cyclical component is positive.

There is probably no co-movement as the female trend lags behind the male trend which results in the data trends not being comparable.

**Part B: Time ­­Series Decomposition**

*Q1)**Fit a linear and quadratic trends to your series. Then, create a line chart with your original series and the two trends. Which trend seems to best fit the series? Explain.*

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The quadratic trend line fits the data better as the calculated value falls within the range of the actual quarterly data series in every annual period, whereas the linear trend only in certain periods bisects the data series.

This finding suggests that the data series reflects the impact of a geometric/compounding influence (such as inflation) rather than a simple arithmetic increase (such as a constant rate of population growth). If the growth in the data were simply arithmetic, then the linear line would demonstrate the better fit.

Instead we see that at the start (1960) the linear trend is below the data series, near the middle (1993) the linear series is above the data series and near the end the linear trend is below the data series (2019).

Therefore, the quadratic trend is a better fit for our data.

*Q2)**Answer the previous question for the series expressed in logs. Does the linear trend fit the log of the series better? Explain why.*

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In the log approximations the linear and quadratic trend lines both demonstrate a good fit with the actual data. This finding is consistent with a rate of growth that is both constant and compounding (such as a constant rate of inflation). In this scenario the linear log line and the quadratic log line both produce good fit since the rate of change is constant over time.

However, we know that the quadratic trend has an extra degree of movement (the x2 term) in comparison to the linear trend, which means that it will have an equal deviation from each value then the linear trend so would give a clearer indication of change. Therefore, based on that logic I believe that the quadratic trend would fit the series better, although with this data set the difference is marginal.

*Q3)**Plot the detrended series using the trend that best fit the series. Briefly describe what you see: Do you better detect short term fluctuations?*

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The detrended data series exhibits high volatility, however we see that on average the peaks get smaller over time and the troughs also get smaller over time. We can also see that the that the average of all observations is slightly very slightly positive (2 \* 10-15). We can also see that the peaks of quarter on quarter growth occur in the third and fourth quarter and the troughs occur in the first and second quarter.

The maximum observed value for the detrended data is 0.07 and the minimum is -0.09. Despite this, the overall growth trend is slightly positive because the peak values are less volatile and have a slightly higher average than the negative average for the troughs.

*Q4)**Using a moving average of order 5, compute the cyclical component of your series. Then, plot the cycle and briefly describe what you see: interpret the values of some peaks and troughs.*

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We can see that the cyclical component oscillates between being positive or negative roughly every 10 years. The lowest value is -0.0354, the highest value is 0.0354. Over the entire 60 years, the average for the cyclical component is essentially zero and because the peaks and troughs are bounded similarly this means that very little bias noise exists and that the cyclical trend will have a minimal net impact on the data series.

As well the 0.0354 is 0.5% of the average term in the log scale data series, which means that it while the cyclical component represents the biggest component in the detrended series it still is much smaller than the seasonal component.

*Q5)**Plot the low frequency of your series and briefly describe what you see.*

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In comparison to the log data series we see a much smoother data trend which represents the combination of the cyclical component and the trend component. We see significant drops in 1962, 1972, 1982, 1990, 1998, 2011, which correspond roughly the cyclical trend having a frequency of once ever 10 years.

The average of the low frequency component only differs by 4.5 \* 10-5 in comparison to the original log scale date series, this number is relatively very small and shows that the low frequency component of the data series on average mimics the data very well so there should be relatively little bias error in the residual component.

*Q6) Compute the seasonal component and represent it on a bar chart (only the 4 quarters). Interpret the four seasonal values.*

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We see that the seasonal values are negative in the first and second quarter, but positive and roughly equal in the third and fourth quarter. Remember in the detrended series we could see that larger troughs existed but there were more consistent peaks. This is echoed in the data as the seasonal Q2 quarter (responsible for the large troughs) is much larger then the individual positive quarters (Q3 and Q4), however the average of Q3 and Q4 equals the average of Q1 and Q2, which shows that the seasonal peaks and troughs on average will be equal but the troughs will have more extreme values.