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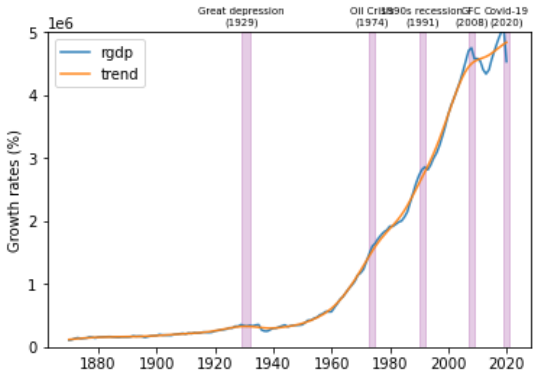
Introduction

In Part I of this assignment we examine the effects of various macroeconomic variables on the business cycle, monetary aggregates and fiscal sustainability in the country of Spain over the period from 1870 to 2020 using the data from the www.macrohistory.net/database/ database. We start our analysis by examining the trend of the real GDP of Spain over time. We then deconstruct real GDP into consumption, investment, government expenditure and net exports and examine the evolution and trend of these variables over time. We then calculate their growth rates. We continue by tracing the path of inflation over time and comparing inflation to the growth rate of the money supply using two different definitions for money. We also test the hypothesis that k (the relationship between the money supply to prices and real GDP) remains constant over time. We then test the correlation between inflation and various loan percentages as well as the total loans under examination. Afterwards we analyse the fiscal sustainability of Spain by inspecting the correlation between inflation, interest rates and GDP growth. We analyse the periods when z>1. We also examine the evolution of Public debt to GDP and the Public deficit to GDP over time. We finish by utilizing the results of our analysis to examine the correlation between the growth of the components of real GDP, inflation and the growth of public debt and the change in real wage growth and unemployment growth over the period from 1939 to 2020.

Exercise 1

We start by conducting business cycle analysis. We examine the trend of real GDP over time (base year: 2005) in the Graph below.

Graph 1.1 Real GDP trend over time

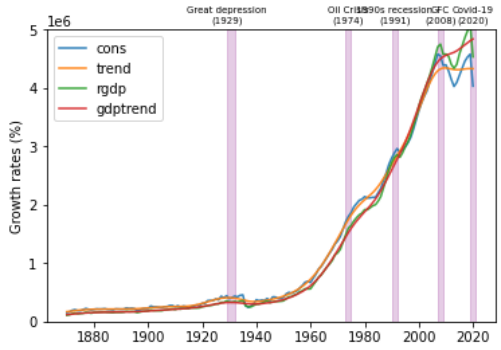


We observe from Graph 1.1 above that despite minor setbacks real GDP has been increasing exponentially since the period after WWII.

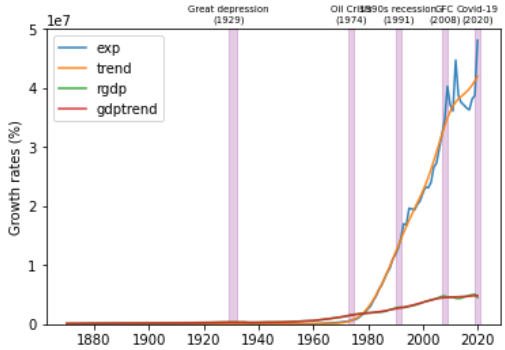
We continue by dividing real GDP into consumption, private investment, government expenditure and net exports (this is consistent with macroeconomic theory as Y = C + I +G +

NX, Y: Total Income or real GDP, C: Consumption, I: Investment, G: Government Expenditure and NX: Net Exports). We then present the evolution of each variable and its trend next to real GDP and its trend in the graphs below:

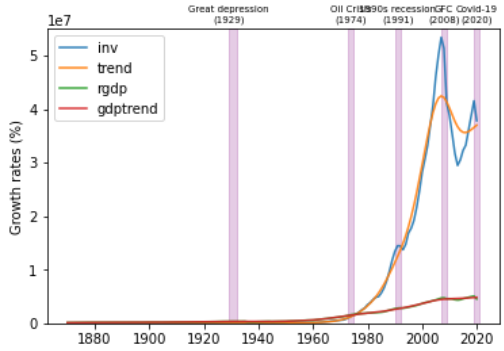
Graph 1.2 Consumption trend over time



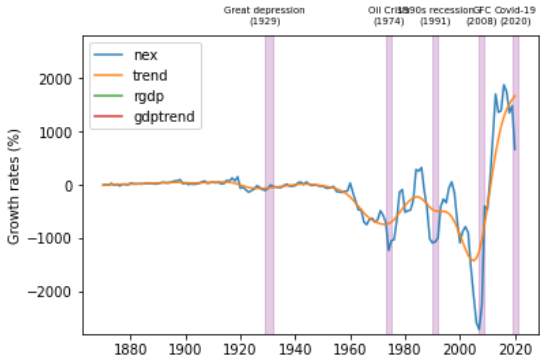
Graph 1.3 Government Expenditure trend over time



Graph 1.4 Investment trend over time Graph



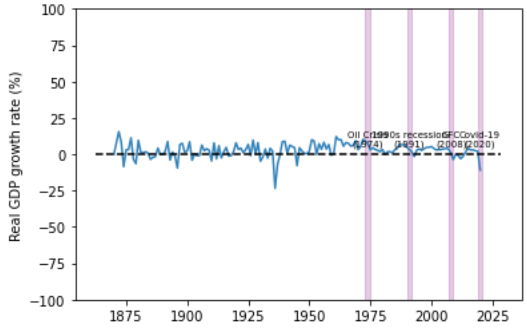
1.5 Net Exports trend over time



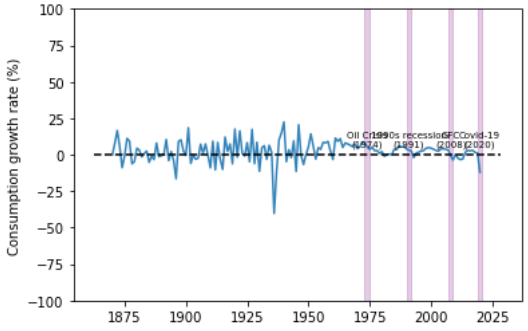
Graphs 1.2 – 1.5 show a clear pro-cyclicality for all GDP components except for government expenditure (seen in Graph 1.3) which is anti-cyclical. This is consistent with the idea that governments become more active in the economy during recessions and increase their expenditure to help maintain stability.

To finish our analysis of the business cycle we calculate the growth rate of each variable over time (growth rate of variable x in period t is $\%\Delta x_t = ((x_t - x_{t-1}) \div x_{t-1}) \times 100$). A visual representation of our findings is showcased in the graphs below.

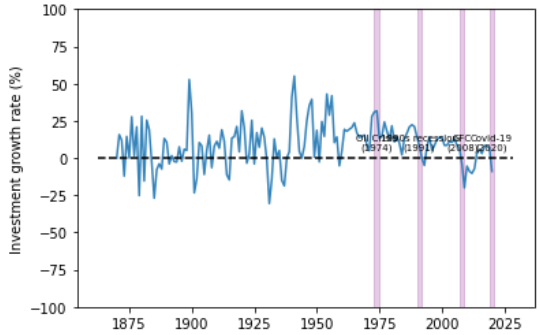
Graph 1.6 real GDP growth rate



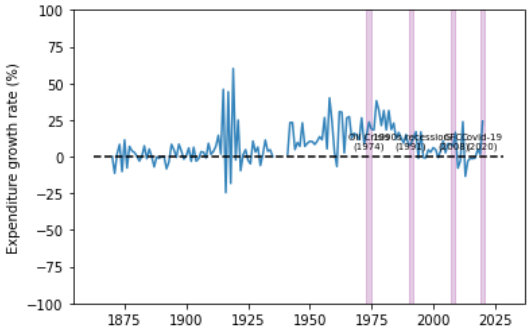
Graph 1.7 Consumption growth rate



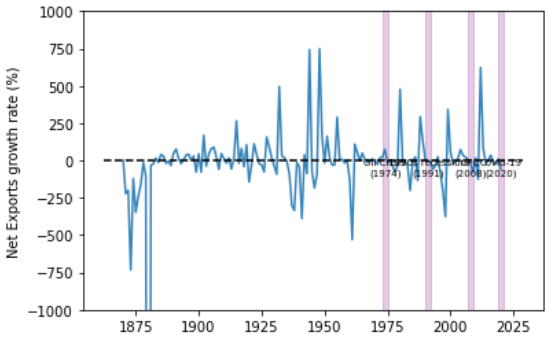
Graph 1.8 Investment growth rate



Graph 1.9 Government Expenditure growth rate



Graph 1.10 Net Exports growth rate



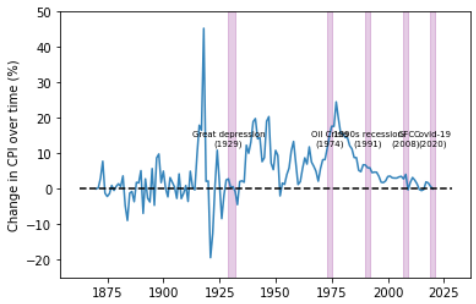
As we can see from the graphs shown above, four out of the five variables under examination seem to slow down during recessions and rise sharply in the following periods. One interesting exception can be witnessed in these graphs. Specifically, government expenditure, as shown in Graph 1.9, tends to increase during recessions. This is necessary as the government needs to take on more responsibility during these periods to maintain economic stability on account of market failure. It is also important to note that both the investment growth rate and net export growth rate are subject to volatile shocks either positive or negative. This is the case for investment in the period after WWII as seen in Graph 1.8, where investment reaches growth up to 60% as a result of the effort of reconstruction after the war. Graph 1.10 shows that net export growth is especially volatile since net exports are the sum of two components, imports and exports, the relationship of which at each point in time can drastically change the value of net exports.

Exercise 2

We continue by conducting an analysis of monetary aggregates. First, we visually present the dynamic path of inflation over time and provide a comparison between inflation and the growth rate of the supply of money using two different definitions for the money supply (M1 - Narrow money: The sum of currency in circulation and overnight deposits plus short run deposits (<2 years) and deposits redeemable at notice up to three months, M2 - Broad money: M1 plus repurchase agreement (repos), money market funds and debt securities (<2 years)). We then calculate variable k over time ($k = M_s \div (P_t \times Y_t)$, M_s: Money Supply, P_t price level in period t, Y_t: real GDP in period t). The Quantity Theory of Money states that k is constant over time. We challenge that assumption. We finish by presenting the relationship between inflation and total loans and the percentage of loans of various economic agents to total loans.

Let's start by presenting inflation over time:

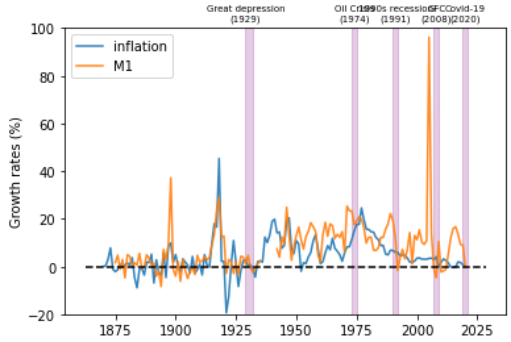
Graph 2.1 Long-run time series of inflation



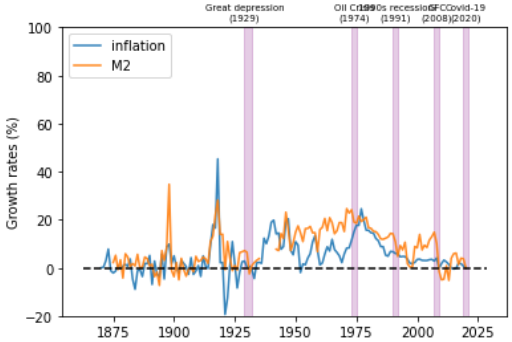
As we can see in Graph 2.1 inflation has mostly remained positive over time (negative values after the 1950s can be attributed to errors). Inflation is more susceptive to negative changes before the 1950s since the economy back then functioned using a gold standard of values. There's a sharp increase in inflation during the 1970s. This result along with the stagnation visible during the same period in Graph 2.1 can be attributed to the oil crisis and is indicative of the phenomenon of stagflation, which first appeared during that period. Other periods of recession such as the 2010s or the covid-19 pandemic show a clear downward trend of inflation.

Now let's compare inflation to the change of the supply of money over time (we use M1 and M2 as mentioned above):

Graph 2.2 Inflation and Money supply growth M1



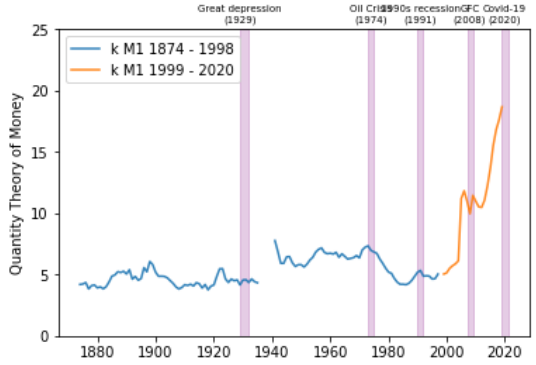
Graph 2.3 Inflation and Money supply growth M2



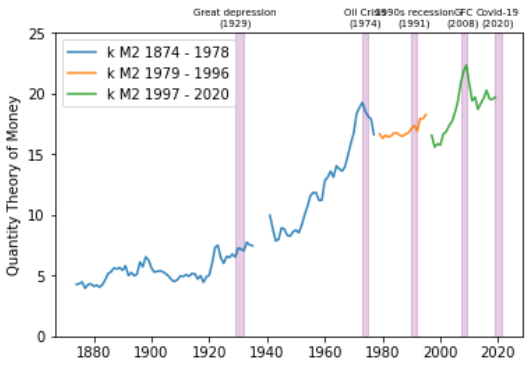
As we can see in Graph 2.2 and Graph 2.3 inflation is positively correlated with the growth rate of the money supply regardless of the definition we use for money. It is important to note that the growth rate defined using M1 seems more volatile during the 2008 financial crisis than the growth rate defined using M2.

We continue by examining the change of variable k over time:

Graph 2.6 k over time calculated using M1



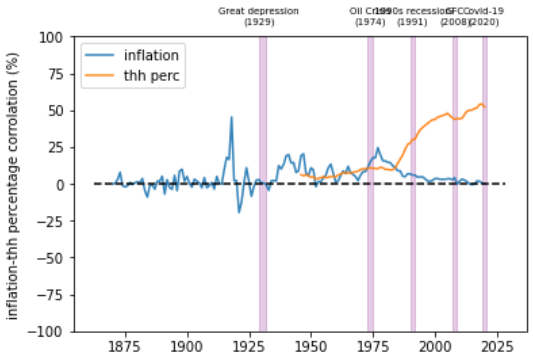
Graph 2.7 k over time calculated using M2



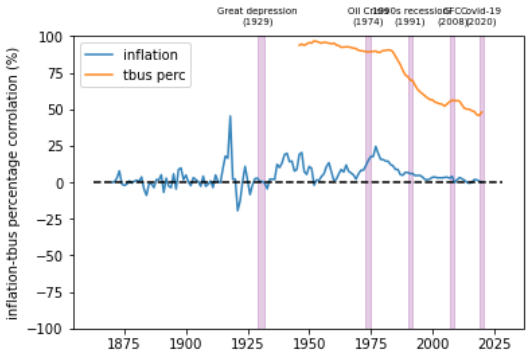
The Quantity Theory of Money states that k stays constant over time. While this conclusion seems consistent with our analysis, by scaling the graph by a factor of 100 we observe a small tendency for k to increase over time. While minor changes could be attributed to a standard error, a better explanation for this tendency is that the velocity of money keeps decreasing due to increase in the supply of money since the 1950s. This explanation is consistent with the tendency of inflation to remain positive since that period. By dividing different time periods based on the data sources used by the microhistory database we can rule out problems that can occur due to inconsistent data especially after the housing crisis of 2008 when using the M1 definition for measurement and the Great Depression of the 1930s when using the M2 definition.

Lastly, we calculate total household loans (THH), total business loans (TBUS) and total mortgage loans (TMORT) as a percentage of total loans. We then present these percentages in correlation to inflation. We also present total loans in correlation to inflation.

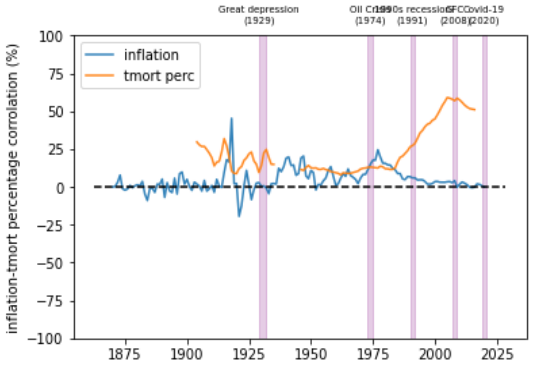
Graph 2.10 THH percentage and Inflation



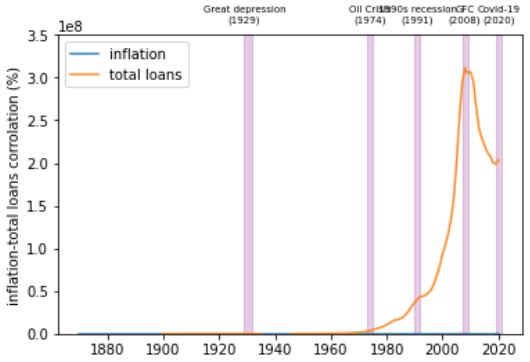
Graph 2.11 TBUS percentage and Inflation



Graph 2.12 TMORT percentage and Inflation



Graph 2.13 Total Loans and Inflation

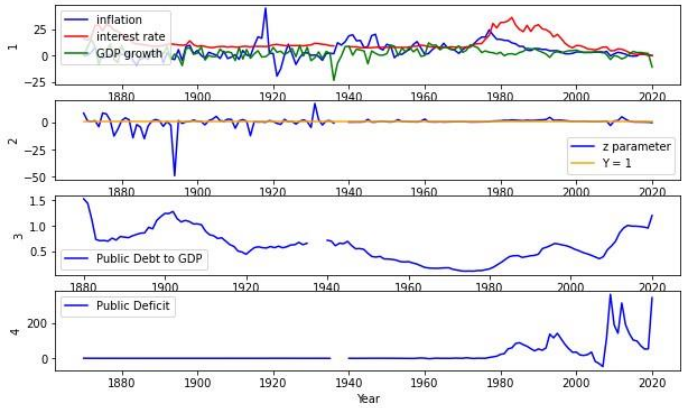


Graph 2.10 and Graph 2.12 hint at a slight negative correlation between inflation, total household loans and total mortgage loans. Graph 2.11 shows a positive correlation between total business loans and inflation which is consistent with our previous observation. Graph 2.13 shows that the correlation of total loans to inflation is basically zero.

Exercise 3

Our final analysis is conducted on fiscal sustainability. We present the correlation between public debt to GDP, interest rates and GDP growth over time. We continue by analysing the change in z_t ($z_t = (1+r_t) \div ((1+\pi_t) \times (1+\gamma_t))$, r_t: interest rate, π_t: inflation, γ_t: real GDP growth) over time, using a line to show when $z_t > 1$. We finish by inspecting the paths of Public Debt to GDP and Public Deficit to GDP over time.

Graph 3.1 fiscal sustainability measures

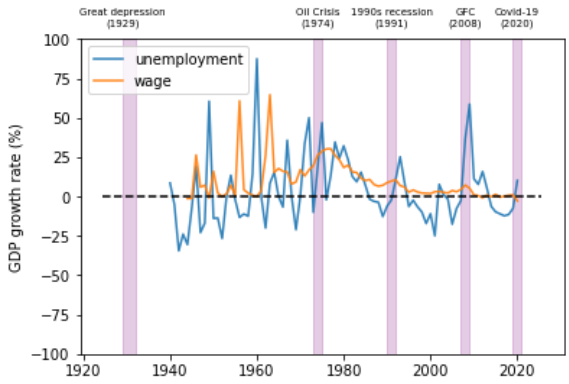


In the first quarter of Graph 3.1 we can see that there is a negative correlation between interest rates and inflation, but a positive correlation between inflation and GDP growth. This is consistent with fiscal sustainability theory since GDP growth drives up spending which drives up inflation, while interest rates encourage saving, which drives down spending and prices and, by extension, inflation. The second quarter shows that interest rates are growing faster than nominal GDP during the period after the 1929 economic depression. The most probable reason is the change in economic policy, since Spain became a member of the Bretton Woods system institutions after WWII. An important exception is seen during the 2009 financial crisis when Spain implemented harsh austerity measures that drove down inflation and economic growth. In the third and fourth quarter of Graph 3.1 we can see that both Public debt to GDP and Public deficit to GDP started rising after the 1980s, possibly due to changes in fiscal policy and then rose sharply during the 2009 financial crisis and then again during the 2020 coronavirus pandemic. The increases during the 2009 crisis have resulted from the fact that Spain was forced to repay its debt, thus, putting pressure on the government's budget. Increases during the pandemic crisis happened due to the need for government spending to support the economy during times of slow economic growth.

Wage growth and Unemployment growth

We finish this assignment by using the data from our dataset to see how the various macroeconomic variables from our previous analysis can affect wage growth and unemployment growth. We focus on the period from 1939 to 2020 since it's the only period with reliable data for unemployment by the www.macrohistory.net/database/ database. We begin by examining the correlation between wage growth and unemployment growth. Afterwards we present the dynamic paths for each of those variables, compared to the paths of real GDP growth, inflation and public debt growth.

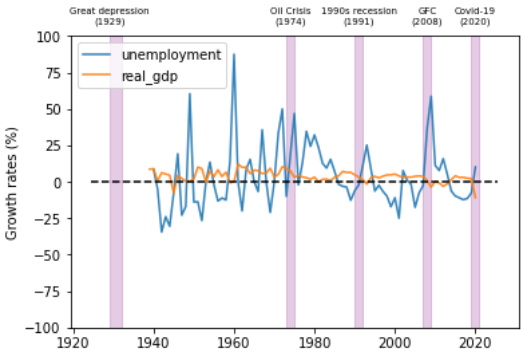
Graph 4.1 Wage growth and Unemployment growth



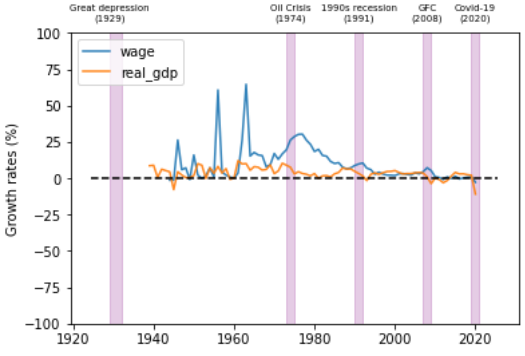
In Graph 4.1 we find a negative correlation between wage growth and unemployment growth. A possible explanation for this phenomenon could be attributed to the worsening bargaining power that workers have during periods of high unemployment (assuming a stable change in the workforce) as the supply and demand for labour are in disequilibrium, with the supply of labour being greater than the demand for it.

We move on to present wage growth and unemployment growth paths along with the path of real GDP growth:

Graph 4.2 Unemployment growth and real GDP growth

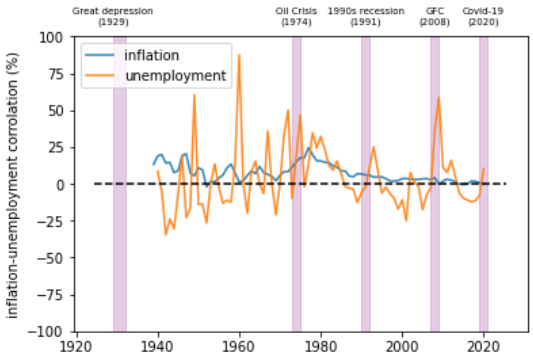


Graph 4.3 Wage growth and real GDP growth

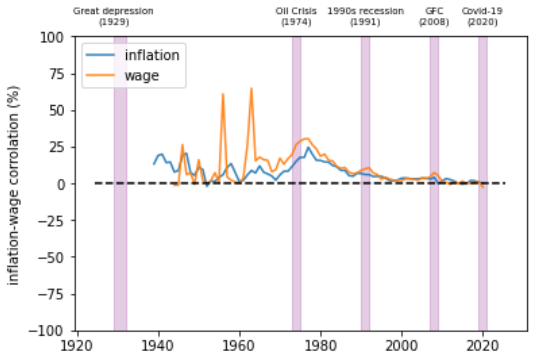


Graph 4.2 shows that unemployment growth is anti-cyclical, meaning that there's a negative correlation between unemployment growth and real GDP growth. Moreover, we can see that unemployment growth is rather sensitive to changes in real GDP growth. In Graph 4.3 we can see that wage growth is a pro-cyclical variable. We note that while wage growth is also sensitive to real GDP growth it almost always appears to have a value greater than zero (slight exceptions can be attributed to a standard error). This will be explained in the next paragraph when we compare wage growth to inflation.

Graph 4.4 Unemployment growth and Inflation



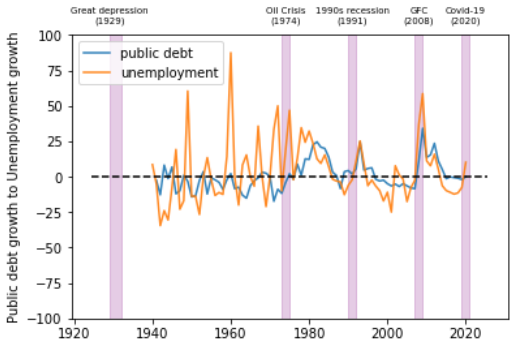
Graph 4.5 Wage growth and Inflation



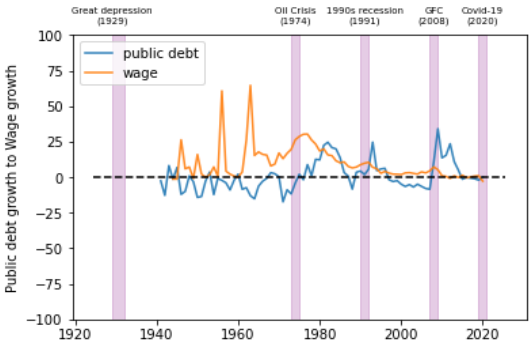
Graph 4.4 shows that unemployment growth and inflation are negatively correlated (this is consistent with the idea behind the Philips Curve). Graph 4.5 shows that wage growth is positively correlated to inflation and, moreover, is rather sensitive to changes in inflation. The reason lies from the fact that income tends to adapt to inflation over time.

We finish our analysis of wage growth and unemployment growth by examining the relationship between these two variables and the growth rate of public debt over time.

Graph 4.6 Unemployment growth and Public Debt growth



Graph 4.7 Wage growth and Public Debt growth



Graph 4.6 and Graph 4.7 show that unemployment growth has a positive correlation to public debt growth after the 1990s. This is explained by the effects of recessions on these variables. Recession periods tend to demonstrate an increase in public debt growth due to the government being temporarily forced to take on a more active role in the economy through subsidies and other similar forms of government policy, thus, public debt growth tends to move in the same direction as unemployment growth.

Conclusion

In this assignment we conducted three forms of macroeconomic analysis, those being business cycle analysis, analysis of monetary aggregates and fiscal sustainability analysis and we used our results to explain the correlation between wage growth and unemployment growth and various macroeconomic variables under examination. In Exercise 1 we divided GDP into its

four main components and found a positive correlation between GDP and its components with the exception of government expenditure. In Exercise 2 we compared inflation to changes in the money supply and found these variables are positively correlated, regardless of the definition we used for the supply of money. We also tested for changes in k and found that there's a slight tendency for it to increase over time especially after the 1980s using both definitions. We then compared inflation to the percentage of household loans, business loans and mortgage loans to total loans and found that inflation has a positive correlation to the percentage of business loans, which comes at the expense of other types of loans compared to total loans. In Exercise 3 we observed the relationship between inflation, interest rates and GDP growth and how monetary policy and recessions can affect the value of z_t. We also examined the paths of Public debt to GDP and Public deficit to GDP and found a tendency for both variables to rise after the 1980s which became more apparent during recessions. Finally, we used the results from our previous analysis and found the correlation between unemployment growth and wage growth to real GDP growth, inflation and public debt growth.