# The burden of public debt on the United Kingdom: Analyzed with VAR approach

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**Abstract**

The study aims to find the relationship in between economic growth and public debt in the United Kingdom using a *Vectoral Autoregression* approach in between 1999 till 2017. The study aims to examine the impact of public debt on interest rates, inflation rates, Real GDP growth rate, and interest debt payments in the UK. The results show a positive and statistically significant impact of public debt on inflation rates and interest rates. It is also found that the variables affect each other as a consequence in the model and therefore public debt also influence the real GDP growth rates and interest debt payments indirectly. The study also suggests that public debt is good only until it is in sustainable levels and used in an efficient manner. Public debt is only analyzed in the short term and is confirmed to create significant economic boost through a fiscal stimulus which cannot be sustained as time passes and the dollar amounts of public debt reach higher.

JEL Classification: H63, O47, E43

Key Words: Public Debt, Economic Growth

## 1.0 INTRODUCTION

Public Debt is defined as the government debt from any source and must not be only limited to the bonds issued by the reserve banks. A country in a closed economy will only be able to spend as much as it earns. However, in today's global environment the fiscal policy can spend more than it earns by raising funds in the form of public debt. Therefore, we know that public debt is a consequence of the fiscal policy for any country. On the other hand, the multiple financial crisis in the last decade have also shown their direct correlation with higher debt. These crisis's have led to an increase in public debt which have been found to hurt the sustainable growth rates of these advanced economies and create instability Raskovic and Moerec (2012). This exponential debt will almost certainly put a country in a debt trap as a result of the unsustainable fiscal stimulus. This failure has been evidently in Greece which has failed to improve its economy even after multiple fiscal stimulating activities. The initial impact of fiscal stimulus is the increased economic growth. However, this impact is low to surface and associated with lag. On the other hand, the changes in expectations also leads to unwanted effect. On the other hand, public debt will create instability in macro factors like investment, interest rate, inflation etc which will be contrary to the results wanted. Islam and Hasan (2007). The Bank of England has also been pushing to create another fiscal stimulus in the market as the economy loses steam due to the Brexit and looms towards a recession Ewing (2019). As the stimulus is virtually an expense to the government it is likely that it will be financed through public debt. Due to these concerning situations the study aims to find solutions to these critical questions: How does public debt effect the long-term interest rates? The burden of public debt on economic growth, interest payments, taxes and the relationship between inflation and public debt.

Public debt is a loan taken by the government and just like any other loan failure to pay the loan lead to bankruptcy. The failure in this case could be due to the usage of the loan in waste actions like paying of previous loan, using the debt to pay interest payments, used to finish projects that have turned out to be more expensive, corruption etc. These actions would lead to a creation of debt trap and also harm the economic growth rate of the country along with higher taxes and higher interest payment and higher long-term interest rates. As we know that national savings are just a combination of public and private savings it is likely that the use of public debt will lead have a crowding out effect on the investment done by the public sector. Therefore,

reducing the overall investment in the economy. Moreover, the interest rates will also rise, which would further hurt the economy. This shakes business expectations and lead to lower investment in the economy from the private sector Krugman (1988). Thus, the economy makes less than the potential output, hence working inside its PPC line.

Most research has been able to come to any concrete conclusions on the fact of whether there is a relationship between economic growth and public debt in developed countries. (Smyth and Hsing, 1995; Cohen, 1997; Pattillo et al., 2002; Clements et al., 2003; Cecchetti et al., 2011; Checherita and Rother, 2010). Much research has also been found in between the sustainability of public debt in developed countries where decreasing the real interest rate will keep public debt in check and will also avoid possibility of inflation due to increased PV of future budget deficit Pekarski (2017). On the other hand, research also found out that interest rates are related to public debt and are affected by the management of the psychology of the debt market. Plus, long term interest rates are affected by the term structure of public debt Aspromourgos (2018).

As of today United Kingdom is a part of European Union, EU has seen a correlation between public debt and market reaction. The research finds out that the fiscal stimulus in the EU is sustainable and has created growth as seen in the government and the financial markets. Moreover, the GDP per capita growth was also surprisingly higher in high debt countries Lyziak, T. and Mackiewicz-Lyziak, J. (2019). However, the problem is the new stimulus as it will increase the debt ratio to a much higher percentage than before, alongside the immediate effects are usually positive and the real effects only surface in the long run.

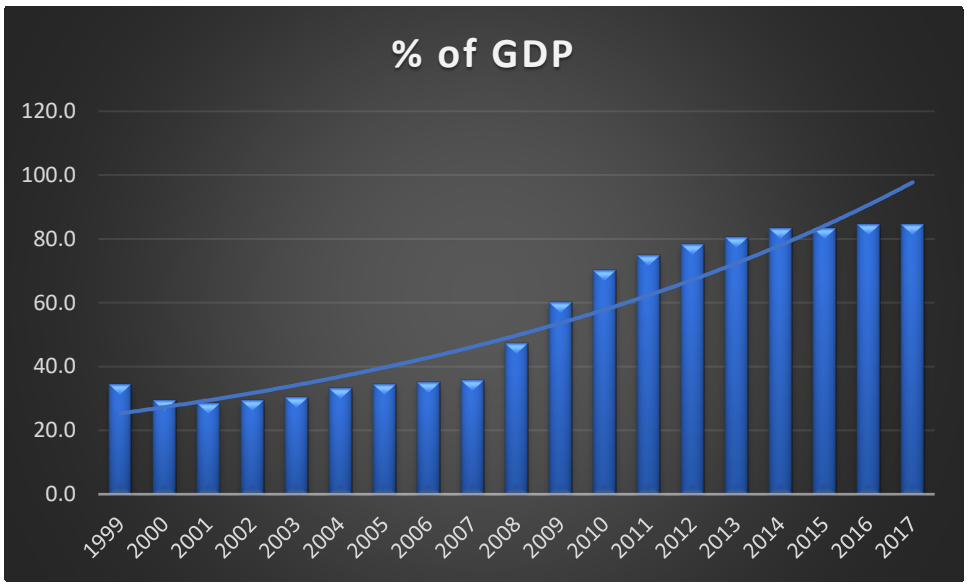
The main objective of the paper is to analyze the impact of public debt on variables like economic growth, interest rates, tax rates and inflation. The paper plan to find out a positive relationship in between inflation and public debt. On the other hand, the paper will disagree and aim to find out a negative relationship in between public debt and economic growth. The relationship will be found out through the SVAR approach. The main reason to do so is to find how public debt effects developed countries different from developing countries. There is not much empirical data with developed countries. Furthermore, providing a contrasting view to the belief that public debt is a good thing for the European Union.

The rest of the paper is organized as follows: Section 3 gives a brief literature review. Section 4 outlines the empirical model. Data and estimation methodology are discussed in section 5 and 6. Finally, section 7 presents and discusses the empirical results. The last section ends the paper with a conclusion.

## 2.0 The trends of Public Debt in United Kingdom

As the figure below depicts the total public debt of the government in the United Kingdom as a % of GDP from the year FY 1998-99 to 2017-18.

**Figure 1: Public Debt as a % of GDP**

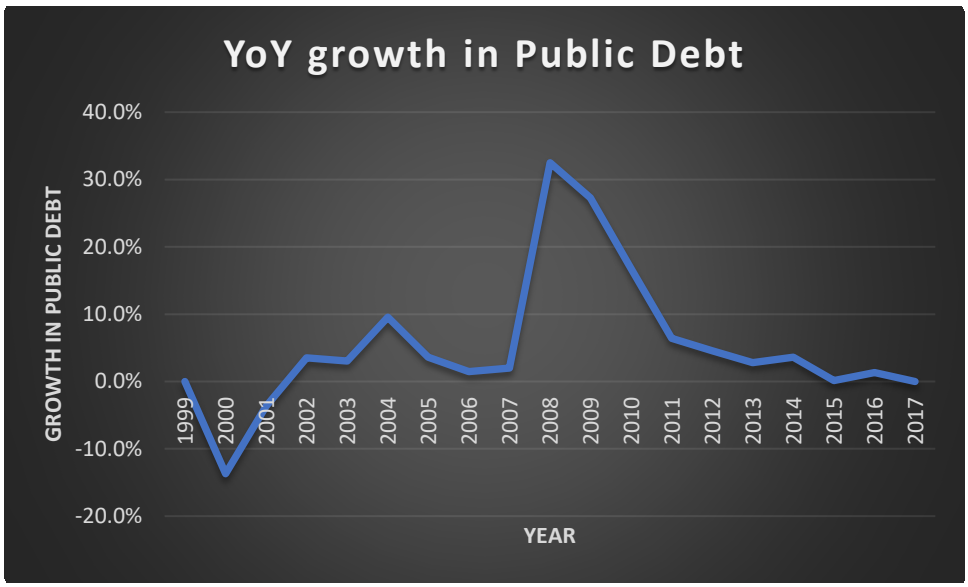



Source: Bank of England

Public debt is the addition of external debt and internal/ domestic debt. Total public debt has increased from 29.6% in FY 2000 to 84.5% in FV 2017. On average, the public debt has increased from 25.51% in between 1997-2007 to 78.6% in between 2007-2017 (Figure 1). The United Kingdom reached a maximum public debt of 84.5%in FY 2017 and a minimum debt of 29.5% in FY 2002. It reached a maximum of 72.34 per cent in 2002-03 and recorded minimum of 45.26 per cent in 1980-8. The trend line shows how public debt is likely to continue to increase in the future years. Mostly because of the slowing economy which needs fiscal stimulus and the threats of recession due to the Brexit. Brexit is likely to create increase

public debt as a % of GDP as the GDP will fall in that situation. Plus, the recession will create a need of a fiscal stimulus as mentioned above.

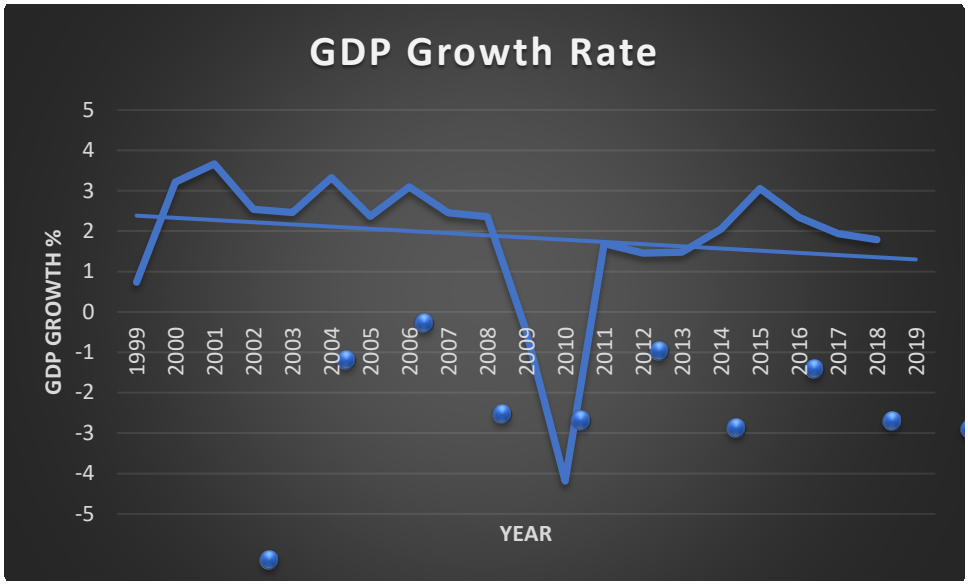
**Figure 2: Year on year growth in U.K. Public debt**




Source: Bank of England

Growth in public debt is shown by any extra borrowing taken by United Kingdom in the year, this is depicted in Figure 2. The graph shows the minimum growth rate occurred in FY 200 where public debt decreased by 13.7%. On the other hand, the maximum growth rate occurred in FY 2008 where public debt increased by 32.5%. The growth in the public debt was mainly created due to the problematic situation of the 2008 recession. The recession hit the financial markets and customer confidence was at an all-time low. Therefore, making it necessary for a fiscal stimulus in hopes of avoiding a recession in the economy. The gradual decrease in overall growth of public debt is seen in the years after as the economy stabilizes. However, the Brexit looms to be an external factor likely to create a similar affect like the counterpart of the 2008 market crash School (2018).

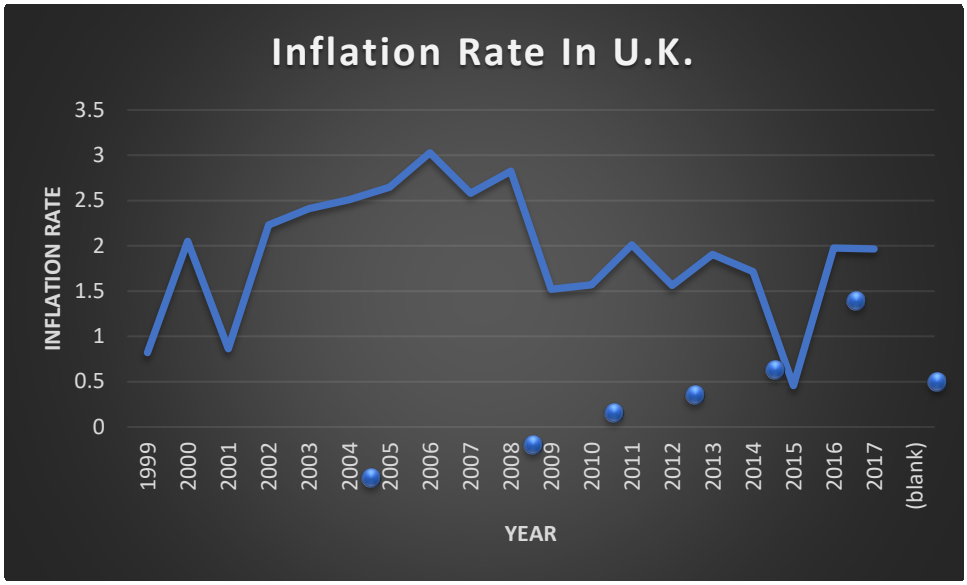
**Figure 3: GDP growth rate**




Source: World Development indicators

GDP growth rate is the YoY increase in GDP. Figure 4 shows the GDP growth that the United Kingdom has experienced over the past 20 years. The maximum growth occurred during FY 2001 where the economy gained 3.66%. On the other hand, the minimum growth occurred during the financial crisis at 4.18% in FY 2010. The average growth rate of GDP since the past 20 years has been 1.867%. The trendline in the above graph shows the gradual decline in the GDP of the country mainly due to saturated markets and high competition from much more resourceful countries. Moreover, Brexit is predicted to create a negative growth in the economy. Furthermore, looking at the historical data above it is clear that the United Kingdom might be in the early contractionary stage. The current inflation rate of 1.8% which is below the 2% target also supports our claim. Contrastingly growth rate dropped after great 2014 mainly due to the announcement of the separation from the EU. On top of that the construction and manufacturing sectors both went into recession Allen (2016).

**Figure 4: Inflation Rate in the United Kingdom**




Source: World Development Indicators

Inflation rate is the percentage increase in the average prices in the economy. The Bank of London has a predetermined target inflation rate of 2% for the economy. Figure 4 depicts the historical data of inflation in the UK. The maximum inflation rate occurred in FY 2006 where the inflation rate was 3.027%. On the other hand, the minimum inflation rate occurred in the 2015 at 0.45% in FY 2015. The average inflation rate in the UK economy over the past 20 years has been 1.928% which is very close to the target rate by the Bank of England. The increased inflation in 2015-16 was due to the high volatility in the energy sector.

## 3.0 Literature Review

Public debt is defined as the total borrowing. The Ricardian equivalence theory argues that public debt has no real impact on the economy (Barro, 1974). In the case of India, we see that there is an adverse impact on economic growth. It was found that in the initial phase there is an influx of fiscal stimulus. However, fiscal stimulus is generated when the country must counter recession soon. Therefore, it is likely that the aim of the stimulus is to counter the effect of lower growth and not increase growth rate. Thus, economic growth is deceptive and cannot be a reliable measure Rath and Bal (2016). The empirical research done by Sliskovic et. al. (2018) in the European Union show how public debt leads to unsustainable growth in the long run due to the inability of the economy to use the funds appropriately. The main variance occurs due to the misuse of funds for interest payments, transfer payments and other non-value adding functions of the economy. On the other hand, positive implications are seen in countries with high debt have a positive correlation between markets and public debt. This is mainly due to higher consumer confidence due to the fiscal stimulus. However, the problem is likely to occur in the long-run as the fiscal stimulus cannot be sustained and the interest rates start rising as the economy starts to heat up. Thus, creating instability in the economy as seen in Greece Lyziack and Lyziack (2019). Additionally, the Ricardian equivalence in the case of India shows that fiscal stimulus like that in the European Union can harmful to the generational neutrality Pradhan (2016).

The research of Huang et. al (2018) successfully establish the negative correlation in between public debt and corporate investment. Through the analysis they pinpoint the crowding out effect to be seen mainly in corporations due to the tightening credit constraints that corporations face after high public debt. The main reason of high public debt is the aspiration for high growth. However, the high growth rates are rarely sustainable in the long run leading to a structural deficiency in the economy after the saturation of public borrowing. Rother and Checherita (2010) uses a 40-year data set from 22 Euro zone countries to depict the relationship in between public debt and economic growth. The research finds out public debt will possibly create a negative growth effect on the economy if it rises above 70%-80% of GDP. Public Debt reduces economic growth by creating changes in private savings and long-term nominal and real interest rates. These hurt the long-term sustainability of the economy. However, the results also

show the sustainability of growth rate with effective management of public debt under 70% of GDP.

Another study conducted by Bilan and Ihnatov (2015) using 28 European member countries and 5 other countries shows the threshold to negative correlation between economic growth and public debt to be 94% of GDP. The data he used ranged from 1990 to 2011 and proved the existence of this threshold and cemented earlier researches that claimed a negative correlation in between public debt and economic growth. The research also proved that once the threshold is passed public debt is firstly unsustainable, creates high interest rates and budgetary constraints leading to long run problems. The research also successfully showcases the difference in between developed and developing countries by differentiating their thresholds for public debt. The threshold is found to be twice higher in developed countries then that of developing countries. Developing countries have such a lower threshold due to lower credibility, higher vulnerability to shocks and higher dependence on external capital transfers.

The current conditions of the United Kingdom with the Brexit has created a unique situation. The country is already at the theoretical public debt threshold of almost 94% of GDP. Moreover, the Brexit is likely to hurt the economy which might lead to a recession, hence forcing a fiscal stimulus which is only possible through higher financing. The higher financing will create a higher chance of negative growth in the economy. Additionally, the UK leaving the European Union means create the need of new studies to evaluate the country as a stand-alone. Plus, there is limited data about public debt in the United Kingdom and other developed countries. Therefore, the impacts of a higher public debt are of an ambiguous nature to the economy of the United Kingdom. Therefore, the study of the impact of public debt on the U.K. economy will open new dimensions of risk on the topic of Brexit.

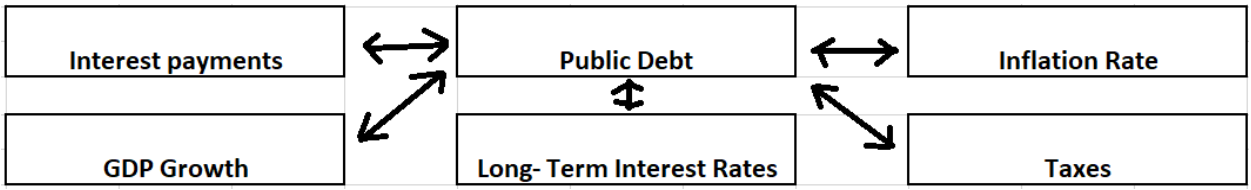
## 4.0 Data and empirical Methodology

Different theoretical arguments and quantitative analysis have led to multiple answers to the question of public debt. However, one certainty from multiple research is that after a certain threshold the likeliness of long-run negative impact on economic growth increases drastically. The Keynesian model specifies that a rise in public debt will lead to an increased level of aggregate demand, output and investment which leads to a healthier economy as mentioned above. The increased debt is likely to increase the demand of money in the market, hence increasing net consumption until the economy slowly sees increasing prices and higher interest rates with increased demand. Therefore, the Keynesian view is based on the favorable effects of public debt.

On the other hand, the underlying issue that is neglected is the fact that the government debt is virtually a debt for the country. Thus, a higher public debt leads to a higher obligation towards interest payments which lead to decreasing overall savings in the economy. Hence, leading to lower investment and consumption in the economy. The only possible way to decrease this pressure from interest is to either reduce expenditure or increase tax revenue; both create a negative effect on the economy. The traditional method contrasts the Keynesian theory basing the facts on the theory of the crowding out effect. The consumers invest their money in bonds and other debt instruments which lead to them thinking that they wealthier than they think. This leads to higher consumption in the short-run which leads to higher demand in the market. With time this consumption leads to higher output and employment. This decrease in marginal propensity to save and increased marginal propensity to consume leads to a decreased overall private savings. This lack of supply in the money market leads to a higher real interest rate in the market. The higher interest rates lead to decrease in the overall investment as investments become less lucrative. On the other hand, public debt keeps increasing as higher interest rates lead to increased foreign inflow of debt. As the investment in the economy continues to stay low the steady stock the overall capital stock grows very slowly which lead to lower levels of output in the long run. Henceforth, the traditional view shows public debt as a burden to the economy in the long-run as the economy will have a smaller output levels, consumption and lower investment.

Erasmo et. Al. (2015) through his research following the 2008 crisis where the paper analyzed the sustainability of public debt in Europe shows another view. They assume that governments cannot possibly commit to repay domestic debt and can thus optimally default due to other commitments. Therefore, raising issues about the sustainability of public debt. Both theories Keynesian and traditional solidify our claim of the interdependency of the variables which then create economic movement.

**Figure 5: Conceptual Framework**




The Framework above represents the interdependence in between the variables and their interdependency with public debt. All variables are also correlated amongst themselves, e.g. Interest payments dictate taxes while inflation increases rates go higher etc.

Figure 5 shows how public debt which is mainly created through the issuance of bonds and other debt securities. This increase in debt instruments drives interest rates higher in the economy as the amount of money in the economy decreases. Holding everything else constant (Ceteris Paribus) the higher interest rates will lead to a decrease in the overall investment by the private sector as they cannot pay the high interest rates. As the government starts paying the interest payments it creates the need to increase its taxes in order to avoid default. The overall increase in taxes leads to a contractionary effect in the economy. Therefore, harming the GDP growth in the long run. The inflation rate increases in the initial phase of the government debt instrument issuance as it leads to higher consumption, whereas the heightened constraints on the economy leads to a gradual decrease. Moreover, governments may also print limited money to cover its interest and debt leading to higher inflation in the economy. In the end, all variables in Figure 5 are endogenous in nature. Therefore, creating a need for the use of a VAR approach which treats each variable endogenous to the system.

Public Debt = F(public debt, Real GDP Growth Rates, Inflation Rates, Interest rates (1)

The literature review is the key driving factor in the creation of the model along with the underlying theories associated with public debt. The model is a combination of three empirical papers by Aristovnik (2014), Bal and Rath, (2016) and Mohanty and Panda, (2019).

### 4.1 Data

The variables that will be analyzed in the paper will be Public debt, Interest payments, GDP growth rate, inflation rate, tax revenue and long-term interest rates. The data will span over a time of 15 years starting from 2002-3 till 2017-18. The paper will use the VAR approach to analyze the time series data. Public debt is taken as a percentage of GDP, it is found from Office of Nation statistics. It is the combination of all kinds of debt that the country has in the form of Bonds, bills, loans etc. This amount is borrowed from the domestic public or the international public. The data for the interest payments is in whole values rounded to Billions, the data is also taken from Bank of England. The amount of interest paid out is directly related to the underlying interest rates in the economy at that time. This is mainly due to the payment of bonds being highly driven through the rates in the market. Interest payments are not counted in the GDP and is wasteful use of public debt. GDP growth rate in the UK economy is presented in the year on year percentage change, the data has been taken from World Development Indicators. Real GDP growth rates are adjusted for inflation in the economy and are measured with constant prices and in terms of output level increases. Inflation rate in the economy is also taken in year on year percentage basis from the Office of national statistics. Inflation rates represent the increase in overall prices in the economy with time due increased demand or decreased supply. Additionally, long term interest rates are presented as percentages. Interest rates are monitored and controlled by the Bank of England through the monetary policy. The fluctuations in them is determined through factors like Inflation and economic growth during the period in assessment. The variables are represented in Table 1 for precise understanding.

**Table:1 Description of Variables**

| | |
|---|---|
| **Public Debt** | *% of GDP* |
| **Interest Payments** | *Dollar amount of the interest payments* |
| **Long-run Interest Rates** | *Interest rate are in %* |
| **Real GDP Growth Rate** | *YoY % change in the real GDP* |
| **Inflation Rate** | *YoY % change in the price level* |

### 4.2 Summary Statistics:

The summary statistics help give us insight on the trends of the data. An important factor to notice is the initial low amount of public debt that the UK had in the start of the dataset which is now replaced by the high 84.5% which exists in the last period of 2017. The other important factor is the high interest rates that have been replaced by much lower interest rates which have fostered economic growth. Additionally, the inflation rate is seen to be very averaging in the dataset at 2%. The 2% inflation rate is also the target inflation rate according to the Bank of England and shows their success in creating stability.

| | ***Public Debt as % of debt*** | ***Real GDP Growth (%)*** | ***Inflation Rate (%)*** | ***Interest Rates (%)*** |
|---|---|---|---|---|
| **Mean** | 58.077% | 0.400% | 2.070% | 2.254% |
| **Standard Error** | 2.788% | 0.078% | 0.115% | 0.254% |
| **Median** | 62.500% | 0.510% | 2.150% | 0.500% |
| **Mode** | 84.500% | 0.760% | 1.300% | 0.500% |
| **Standard D.** | 22.304% | 0.624% | 0.923% | 2.031% |
| **Range** | 55.130% | 3.620% | 4.200% | 5.500% |
| **Minimum** | 29.370% | -2.260% | 0.300% | 0.250% |
| **Maximum** | 84.500% | 1.360% | 4.500% | 5.750% |
| **No. Of Obs.** | 64 | 64 | 64 | 64 |

### 4.3 Methodology

The Vectoral Auto-regression is used to showcase the dynamic relationship in between Public Debt and the multiple variables. The VAR model is used to capture the linear interdependencies in between multiple time series. Thus, being able to accommodate the macroeconomic variables. The only possible problem in the data will be the stationarity in that model. This stationarity of the model is removed by taking the difference of the periods. Additionally, the model will have lag variables of up to 2 periods which will to showcase the effect of prior periods in respect to the coming period. The T-statistic will be used to find the significance of the variables in the model. A threshold of a score above 1 for the t statistic will be taken to be significant in the interpretation of the results. Moreover, as VAR is very interrelated the usage of the overall significance will be used to interlink variables for more cohesive results from the model which can be used for the economic threat imposing the United Kingdom.

## 5.0 Regression Results

| | Public Debt as a % of GDP | Real GDP Growth Rate | Inflation Rate | Interest Debt Payments | Interest Rates |
|---|---|---|---|---|---|
| **Public Debt as a % of GDP (-1)** | 1.350183 | -0.06319 | 0.121466 | 4.18E+09 | -0.032298 |
| | [ 10.3264] | [-1.00752] | [ 2.46015] | [ 0.14073] | [-1.26110] |
| **Public Debt as a % of GDP (-2)** | -0.323133 | 0.042086 | -0.136521 | 7.89E+09 | 0.013213 |
| | [-2.37368] | [ 0.64451] | [-2.65579] | [ 0.25502] | [ 0.49552] |
| **Real GDP Growth Rate (-1)** | 0.314313 | 0.364828 | 0.052432 | -2.13E+09 | 0.047070 |
| | [ 0.97905] | [ 2.36907] | [ 0.43251] | [-0.02912] | [ 0.74854] |
| **Real GDP Growth Rate (-2)** | -0.434984 | 0.125338 | 0.080572 | -5.40E+10 | 0.090226 |
| | [-1.47990] | [ 0.88897] | [ 0.72593] | [-0.80833] | [ 1.56717] |
| **Inflation Rate (-1)** | 0.241853 | -0.313679 | 1.266629 | 1.10E+11 | -0.131256 |
| | [ 0.71064] | [-1.92143] | [ 9.85592] | [ 1.42578] | [-1.96896] |
| **Inflation Rate (-2)** | -0.135563 | 0.249479 | -0.422992 | -1.84E+11 | 0.132849 |
| | [-0.38223] | [ 1.46643] | [-3.15840] | [-2.28450] | [ 1.91234] |
| **Interest Debt Payments (-1)** | -1.69E-13 | 3.52E-13 | -2.34E-13 | 0.648822 | 1.18E-13 |
| | [-0.27159] | [ 1.17960] | [-0.99449] | [ 4.58542] | [ 0.97030] |
| **Interest Debt Payments (-2)** | -1.89E-13 | -3.08E-13 | 4.21E-13 | 0.155271 | 9.15E-15 |
| | [-0.29919] | [-1.01304] | [ 1.76233] | [ 1.07882] | [ 0.07378] |
| **Interest Rates (-1)** | -1.407749 | 0.185520 | 0.173444 | 1.39E+11 | 1.429955 |
| | [-2.13979] | [ 0.58787] | [ 0.69817] | [ 0.92719] | [ 11.0966] |
| **Interest Rates (-2)** | 1.524772 | -0.405976 | -0.209035 | -1.54E+11 | -0.567714 |
| | [ 2.29638] | [-1.27463] | [-0.83370] | [-1.02045] | [-4.36509] |
| **C** | -0.00088 | 0.019198 | 0.004193 | 3.88E+09 | 0.008470 |
| | [-0.05866] | [ 2.66798] | [ 0.74028] | [ 1.13815] | [ 2.88262] |

| | | | | | |
|---|---|---|---|---|---|
| **R-squared** | 0.998477 | 0.574121 | 0.878430 | 0.982220 | 0.993170 |
| **Adj. R-squared** | 0.998178 | 0.490616 | 0.854592 | 0.978734 | 0.991831 |
| **Sum sq. resids** | 0.004515 | 0.001039 | 0.000644 | 2.33E+20 | 0.000173 |
| **F-statistic** | 3343.104 | 6.875243 | 36.85101 | 281.7373 | 741.5894 |
| **Number of coefficients** | 55 | 55 | 55 | 55 | 55 |

## 6.0 Interpretation of results

R^2 is a measure of efficiency of the regression output of the model. In this model, there are multiple R^2 as the regression is processed for each individual variable in an individual manner. The results showcase the R^2 in significant under 20% for all the variables except Real GDP Growth Rate. However, the reason for the low R^2 in this situation is doe to the high correlation in between the inflation rates, interest rates and the Real GDP growth rate. Moreover, public debt also sets expectation in the economy and directs much of the government consumption accordingly. Plus, inflation rates have and R^2 of 87.8% which is significant under 20% but is somewhat not as accurate as we would like it to be. The other variables namely public debt, interest debt payments and interest rates are all significant under 5% which is the accuracy levels that we are looking at. The reason why these variables are much more significant is due to them being much more randomly distributed. On the other hand, each result will be going through the T-test to determine whether it is statistically significant or not. Only statistically significant variables will be used for the analysis.

The results in the model show that Public debt with one lag is statistically significant in effecting inflation rates and public debt for the following period. Public debt usually leads to the creation of more public debt as the interest payments tend to catch up after some time, visa-versa. Additionally, real GDP growth of a lag period of one will be an influencer of the Real GDP growth in the next year. As the Bank of England aims to create stable real growth this is as expected. On the other hand, it is also found that the Real GDP growth rates also tend to have influence in the inflation rates after 2 quarters (2 periods= 2 lag). This result reinforces our literature which shows of real GDP growth influencing inflation rates. This is mainly due to the expectations that the public has.

Inflation rates create a direct impact on the amount of interest payments that will be paid, this is mainly because government bonds are usually paid in amounts that are dictated by the market interest rates. The inflation rates also effect the way in which inflation will work in the coming periods. Additionally, the inflation rate will also affect the interest rates in the span of 2 periods, this is probably due to the correction done through monetary policy with the aim of stability. Inflation rates also effect the growth in real GDP growth rates. Interest debt payments have a major impact on the Real GDP growth rates and the to come interest debt payments. If the payments made in one period are high it is likely that the next period will have a similar amount to be paid. Plus, a higher amount of interest debt payments would mean that lower GDP as payments for interest are not included in the GDP. In 2 periods the interest payments will influence the interest debt payments as explained above. It also effects the inflation rates significantly in our model.

The last variable interest rates have been found to only influence the interest rates of the coming period. This is mainly since interest rates have been only gradually going down in our data set which has data from 2002 till 2017. This is also due to the 2008 recession which influenced the overall decline in the interest rates. Therefore, irrespective of the situation in the economy the Bank of England has tried to keep very low interest rates in the economy. The variables that have been discussed above are only the ones that have been found significant in our model. All variables that were found to be insignificant have been discarded.

The results also show that public debt will lead to more public debt and cause higher inflation in the economy by 0.12% increase. This proves our literature associated with inflation rates. The higher inflation is the impact of the high fiscal stimulus in the economy. This also will tend to grow real GDP growth rates in the economy by 0.36% increase. However, the fact that their will be a positive short-term Impact is now clear. The model is only able to predict the short-term effects as the data is only limited to the prediction of up to 2 quarters in the economy. On the other hand, during the entire data series the public debt levels were below 85% which is the threshold for sustainable debt.

The research confirms that Public debt will influence the inflation rates as the economy will heat up due to the fiscal stimulus created which will indeed also lead to an increased real GDP growth rate. However, the sustainability of this growth is not achievable as it will end as the interest payments plus the principal will get higher as debt matures and will eat a large portion of the GDP. Hence harming the overall growth of the economy.

The model is in consistency with research findings of Bal and Nath (2016), and Checherita and Rothera (2010). Therefore, the research helps support the literature review and make relevance to the Brexit situation arising in the United Kingdom. Bal and Nath showed the burden of public debt in the India. They focus their research on the sustainability of debt. This research paper connects with theirs by showing how United Kingdom is reaching an unsustainable level of public debt which will backfire in the long run and lead to a fall in the growth of real GDP and higher interest rates.

Our model is not able to incorporate the long-term possible effects of the public debt due to the lag periods. This also provides a further place of research in this area. The limitations also exist in the lack of desired R^2 for Real GDP growth rate. Moreover, the fact that the Bank of England focuses so much on stability of inflation rates and interest rates in the economy it often does not give much importance to the amount of public debt being accumulated in order to achieve these objectives. Future research might focus on making this model predict the long-term impacts of public debt in the economy and show results in the economy with different levels of public debt starting from 85% of GDP which is the threshold as of now.

## 7.0 Conclusion and policy implications

Public debt has a drastic impact on the overall wellbeing of the economy. In recent years the issue in much of the literature has been revolving around the sustainability levels of public debt. This issue has been highlighted mainly since the disasters of unsustainable debt with Greece (177%), Japan (230%), Italy (132%) and Portugal (130%). These developed nations are currently struggling on how to pay back the debt. Theoretically even if a country devotes 10% of its GDP towards debt repayment it will take more than 10 years plus the interest. This situation creates a sense of urgency on the topic. The issue when looked from the Ricardian theory would seem like public debt has no effect on the economy and the classical view also insists that the market would fall back to its equilibrium in the long run. However, the issue is still grave as we look at it through the Keynesian view which shows how in the long run the equilibrium can only be reached through high inflation and slowing GDP growth. Additionally, our model and the research of other solidify the fact that public debt after a certain level is unsustainable and the interest debt payments itself kills the economy. As of now the UK is paying about 4% of its GDP as interest payments and this will only rise with an increase in interest payments.

The other issue on hand, will be the use of public debt. Since the start of high levels of public debt in the UK the economy has been growing gradually. However, public debt has also been increasing at a similar pace. From the literature the need for debt financing only occurred in 2008-2010. However, the increase in public debt has been constant even after that period. Therefore, maybe the debt after the initial phase has been used for refinancing purposes and for transfer payments etc. leading to the unproductive usage. To answer these gruesome questions the study answered these questions (1) How does public debt effect the real GDP growth-rate (2) Is there a relationship in between public debt and inflation rates, (3) The short term effects of public debt on interest debt payments and interest rates and their possible long term implication. The model is limited to the United Kingdom data in between 2002 and 2017. Moreover, we also took a robust test separately for all the variables in order to establish the efficiency of each of the variables namely public debt, interest rates, interest debt payments, inflation rates and real GDP growth rate.

In order to successfully be able to mend the issue of public debt, United Kingdom should try to prolong the time that it gets for Brexit. After doing so the United Kingdom will be able to successfully be able to reduce the overall risk of the economy and hence decrease the shock. The decrease in the magnitude of the shock to the UK economy will lead to the need of less public debt. Therefore, keeping the public debt in check. Additionally, planning an overall reduction in debt through printing money (Seigniorage), even though this will lead to inflation if done in a systematically planned manner will result in the reduction of the principle public debt and help the economy.

The paper could also be the basis for future research into the matter of how much public debt will be needed for the United Kingdom to successfully be able to wither the storm of Brexit and not let any harm come to the UK economy. At the same time, research could also explore other possible solutions to the problem of the upcoming recession that will be the result of Brexit.

Furthermore, the stationarity of the data is removed by taking the difference of the variables and then running the VAR model with a lag of 2. Therefore, being able to create a cohesive dynamic VAR model. The model has an issue of not being able to recognize the long-term impact of the variables due to the complexity and data constraints. Economic growth will be affected by the public debt in the short run and will create inflation in the economy. We also conclude that the interest rates are somewhat unvaried by the public debt due to the Bank of England intervening constantly this creates stability but also skews the data in favor our hypothesis that public debt will crowd out investment by raising the interest rates. Therefore, we can conclude that the Ricardian theory does not apply with the current state of the UK economy. It will be best to keep the public debt levels in check and try to avoid Brexit, if possible. Furthermore, if that is not possible then the UK government might want to try to limit public debt as it will reach unsustainable levels very rapidly and harm the economy.

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