Decomposition of Debt-GDP Ratio for United Kingdom: 1984-2009 *

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Abstract
Most advanced nations today are witnessing a peace-time public debt surge that match post World War levels. This raises concerns about fiscal financing and liquidation of the stock of debt specially in the face of changing demographics. United Kingdom being one of the advanced nations with a high level of public debt and an aging population is facing similar issues of fiscal financing. This paper attempts to decompose the evolution in the debt-to-GDP ratio of UK between 1984-2009 into nominal returns, inflation, GDP growth rate and primary deficit. The results of the decomposition show that the government of UK did inflate away part of the debt but most of the adjustments was due to the low interest rates and the changes in the primary deficit.

Key words: Public Finance, Sovereign debt, Inflation.

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1 Introduction

Peace-time build up of public debt is a phenomenon that is new to most advanced and emerging nations that have been involved in the two World Wars. A debt-to-GDP ratio close to a 100 or even higher was common among nations and most did manage to retire the debt towards the end of the 20th century. However, the cause of concern for the present day world is the peace time surge in debt-to-GDP that is close to the War time levels. Declining growth rates and burgeoning fiscal deficits and aging population raise the obvious question about fiscal financing in the advanced parts of the globe. And it is in the light of such events that one calls for an analysis as to how the government had liquidated previous levels of debt to help understand what kind of adjustments to except in the future.

United Kingdom, the sixth largest economy is one of the advanced economies that ranks high amongst high debt countries in recent times. After the 2008 recession government debt as a percentage of GDP for the United Kingdom stood at 72.7 percent in 2010 and is estimated rise to about 88 percent in 2014 (World Economic Outlook 2010, IMF). Although such high levels of debt is not new to the UK, a cause of concern are the demographics and the double digit deficit figure.

Apart from the concerns related to the burden of debt on the future generations, inflation and sustainability of such high levels of debt, mechanisms for financing the debt is also important. An aging population and high levels of social expenditure raises doubt as to the kind of adjustments that would be undertaken to retire such massive stock of debt. Such high debt levels and the accompanying fiscal issues has serious implications for the fiscal instruments that might come into play to retire the high stock of debt. That such claims hold good is evident upon comparing the situation of UK with the United States that has a debt-GDP ratio of about 96 percent as of 2010 and demographics similar to that of the UK. The dynamics of fiscal financing in the US point towards adjustment in government spending, lump-sum transfer, capital and labor taxes in order to stabilize debt (Leeper, Plante and Traum(2010)).

As an alternative to considering the effect of debt on the decision-making economic agents it
is worthwhile seeing as to how the government in the past have tackled the high levels of debt. Simple manipulation of the government budget constraint reveals nominal returns, inflation, GDP growth rate, primary deficit and also the maturity structure of the debt to have direct bearing on the debt-GDP ratio at a particular time period. Such analysis help in understanding as to how each component may have helped the government retire high levels of debt in the past and thereby get some idea as to how the government may go about handling the present scenario.

This paper undertakes a similar decomposition as outlined in Hall-Sargent (2010), for the debt-GDP ratio for UK between 1984 and 2009. Essentially this study seeks to analyze the contribution of the components namely, nominal returns, inflation, GDP growth rate and primary deficit that affected the debt-to GDP ratio to analyze the peace-time surge in the public debt level. The study finds that at times the government did manage to inflate away part of its debt specially between mid-1980s and early 1990s but not much since it started targeting inflation from mid-90s. Also, maintaining low nominal interest rate, helped with a low interest payment burden on the government. However, of all the components that did affect the evolution of the debt-GDP ratio in any particular period, primary deficit or surplus, did play an important role.

The rest of the paper is organized as follows. Section 2, discusses the background of the economy of the United Kingdom with reference to the level of debt and the path of interest rates. Section 3 takes up the related literature followed by section 4 that provides the details of the decomposition technique. Section 5 discusses the data with section 6 laying out the results. A comparison between US and UK is undertaken in section 7 and section 8 concludes.

2 Background

During the period of 1900 to 1914, debt to GDP ratio for UK was less than 50 percent and remained so until about 1915, when it started to escalate. However, with the onset of the first and the second World Wars the debt to GDP ratio spiked and reached unprecedented levels of 200 and 270 percentage points respectively. As figure 1 shows, around the 1950s the debt percent started to decline so that by the 1980s the percentage was close to 50. However, there was a gradual rise
in the debt percent since the early 1990s.

![Figure 1: Public Debt as percent of GDP](image1.png)

Source: HPDD (IMF)

Figure 2 plots the nominal marketable payments made by the government of UK as a percent of GDP over time and by maturity of the debt portfolio. It is observed that the nominal marketable payments as a percent of GDP had been high during the 1960s and the pay outs gradually decline over time. However, post 2005 the pay outs begin to rise specially for securities with less than ten years maturity. Comparing the maturity structure of the debt it is seen that over the years since the 60s there is a decline in the maturity of the issued debt with securities of shorter maturity being preferred to the longer ones.

![Figure 2: Promised Nominal Marketable Payments by Date and Maturity](image2.png)

Figure 3, shows the real return calculated over the period 1965-2009 against the maturity structure of the debt. Real return, defined, as the return on nominal securities that the government has
to pay to the bearer of those securities after adjusting for inflation. Between the mid-70s and the 
mid-80s government had to pay high real returns on account of securities with maturity over 15 
years. And at times real returns have also been negative so that inflation did help reduce the real 
return payments of the government. Beyond mid-90s real returns were much less and has also been 
negative at at times.

Therefore, the government of UK by keeping the real interest rate low did manage to liquidate 
some of its debt during the mid-60s and also post 2000. Low interest rates and higher levels of 
inflation, both these components helped reduce the high debt stock. Reinhart-Sbrancia(2011) also 
document this where they show how the government of UK like many other governments facing 
high levels of public debt used “financial repression” in the form of low real interest rates and higher 
inflation to liquidate high stocks of debt.

3 Related Literature

High levels of public debt and the subsequent adjustments made by nations historically have been 
well documented in the literature. Notable among them is the study by Reinhart-Rogoff (2008) 
that uses a comprehensive new historical database spanning sixty-six countries in Africa, Asia, Eu-
rope, Latin America, and Oceania and spanning eight centuries. They show that rising debt levels 
and the subsequent defaults by the government on external and domestic debt are not new phe-
nomenon. Serial default was not uncommon for nations in the path to transition from “emerging”
to “advanced” and that high inflation, currency crashes and, debasements occur simultaneously with default. Historically, sovereigns have practiced default and that “currency debasement” was a form of default and data reveal expropriation through currency debasement in Europe during 1258-1899.

The relation between inflation and debt in the form of public debt, external and domestic debt across countries have been discussed in Reinhart-Rogoff (2010). Employing data from forty-four countries over a period of two hundred years, they study the relation between high debt levels and inflation for advanced and emerging economies. Whereas for advanced countries as a whole they find no apparent contemporaneous link between inflation and public debt levels, an exception was the US that did experience high inflation when the debt to GDP ratio was high. For emerging economies, however, they find inflation rising sharply with rising debt. With regard to external debt for emerging economies they find that inflation is significantly higher for the countries with external debt over 90 percent. On the domestic debt front they present evidence that historically domestic debt may be associated with high inflation episodes. Besides, they also observe that high public debt levels have implications for growth rate in emerging and advanced countries alike, so that growth rate on average is lower at higher levels of debt.

Reinhart-Sbrancia (2011) address the issue of debt restructuring via “financial repression” that occurred in advanced and emerging economies alike between 1945 and 1980.1 They show that such repression did help reduce the debt burden in the post World War II decades for many advanced economies and also for emerging nations that faced financial repression prior to financial liberalization. They further document that financial repression prevailing for several decades (1945-1980), played an instrumental role via inflation, controlled interest rates and directed credit in liquidating the massive stock of debt. For the UK, the domestic deregulation of interest rates took place in 1981 with the government subsequently withdrawing its guidance on mortgage lending in 1986.

Scott-Giannitsarou(2006) addresses the question of sustainability of the high peace-time surge

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1 Reinhart-Sbrancia(2011) lay out the features of financial repression to include explicit or indirect caps or ceilings on interest rates, creation and maintenance of a captive domestic audience and direct ownership of banks or extensive management of banks and other financial institutions.
in debt level and analyze the fiscal sustainability of the governments in OECD countries rising deficit levels. They find that between 1960 and 2005, for US, UK, Japan, Italy, Germany and Canada, adjustments in primary deficits mostly helped remove the fiscal imbalances with less important adjustments through inflation and GDP growth rate.

Hall-Sargent(2010) undertake a decomposition of the debt-GDP for the United States in the post World War II era between 1945 and 2009. Using central government marketable and non-marketable debt data they show how inflation, GDP growth rate, nominal returns and primary deficit have helped explain the change in the debt-GDP ratio during any particular period. They arrive at the conclusion that although the US government did at times inflate away the debt it was not successful in doing so in all of the periods under consideration. However, the component that did play a major role in affecting the change in debt-to-GDP ratio was the GDP growth rate.

4 Debt Decomposition

Simple manipulations of the government budget constraint leads to the following equation:

$$\frac{B_t}{Y_t} = (r_{t-1,t} - \pi_{t-1,t} - g_{t-1,t}) \frac{B_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t} + \frac{B_{t-1}}{Y_{t-1}}$$

(1)

where, $Y_t$ is the real GDP at time $t$, $B_t$ is the real value of debt issued by the government to the public, $r_{t-1,t}$ is the nominal interest rate between time $t$ and $t-1$, $\pi_{t-1,t}$ represents inflation between time $t$ and $t-1$ and $g_{t-1,t}$ is the growth in real GDP between time $t$ and $t-1$ and $def_t$ represents the deficit net of interest payments at time $t$.

Debt $B_t$ consists of both nominal and inflation-indexed components that varies with the maturity structure of the debt. Accordingly $B_t$ would be the sum of $\tilde{B}_t^j$, the real value of nominal debt at $t$ and $\tilde{B}_t^j$, the inflation-indexed bonds of maturity $j$ at $t$. Therefore, the modified version of the above equation is the following:

$$\frac{\tilde{B}_t + \tilde{B}_t}{Y_t} = \sum_{j=1}^{n} \tilde{r}_{t-1,t}^j \frac{\tilde{B}_{t-1}^j}{Y_{t-1}} - (\pi_{t-1,t} + g_{t-1,t}) \frac{\tilde{B}_{t-1}^j}{Y_{t-1}} +$$

7
\[
\sum_{j=1}^{n} \bar{r}_{t-1,t}^j \frac{\bar{B}_{t-1}^j}{Y_{t-1}} - g_{t-1,t} \frac{\bar{B}_{t-1}^j}{Y_{t-1}} + \frac{def_t}{Y_t} + \frac{\bar{B}_{t-1} + \bar{B}_t}{Y_{t-1}}
\]

where, \(\bar{r}_{t-1}^j\) is the net nominal holding period return between \(t - 1\) and \(t\) on nominal bonds of maturity \(j\) and \(\bar{r}_{t-1}^j\) is the net real holding period return between \(t - 1\) and \(t\) on inflation indexed bonds of maturity \(j\).

In order to analyze the contribution of each component, considering \(\tau\) to be an initial period, equation (2) is iterated to arrive at the following equation that shows how the change in debt-to-GDP over the period \(t\) and \(t - \tau\) depends on the nominal returns, inflation, GDP growth rate and primary deficit.

\[
\bar{B}_t + \bar{B}_t - \bar{B}_{t-\tau} + \bar{B}_{t-\tau} = \sum_{s=0}^{\tau-1} \left\{ \sum_{j=1}^{n} \left( \bar{r}_{t-s-1,t-s}^j - \pi_{t-s-1,t-s} - g_{t-s-1,t-s} \right) \frac{\bar{B}_{t-s-1}^j}{Y_{t-s-1}} \right\} + \sum_{j=1}^{n} \left( \bar{r}_{t-s-1,t-s}^j - g_{t-s-1,t-s} \right) \frac{\bar{B}_{t-s-1}^j}{Y_{t-s-1}} + \frac{def_{t-s}}{Y_{t-s}}
\]

5 Data

The debt securities issued by the British government commonly known as “gilts” and in particular conventional gilts make up the largest share of the British government debt. The data analysis is restricted to the marketable portion of central government debt comprising of conventional gilts, treasury securities and inflation-indexed gilts. The present data set excludes the non-marketable portion of the UK National debt comprising of National Saving certificates, Certificates of tax deposit, IMF interest free notes etc.

5.1 Source

This subsection lays out the data sources for Debt, Yield and National Aggregates used in the analysis.

Debt : The data on conventional gilts, treasury securities and inflation-indexed gilts have
been obtained from the Debt Management Office (DMO). Established on April 1, 1998, the DMO has been responsible for the management of the Gilt-market and in general of the government debt. The Heriot-Watt University and Faculty and Institute of Actuaries’ British Government Securities Database (BGSD) is available via the DMO website that served as the main source of government securities data used in this analysis. The BGSD provided the details about the British securities required for the decomposition. Essentially this database provided the data on securities consisting of date of issue, coupon rate, type of issue and date of maturity of each securities issued by the government since 1964.

Yield: The figures for the yield curve have been taken from the Bank of England’s calculations pertaining to government bonds. In particular the archive consisting of the forward curve of the government securities with maturity ranging from six months to 25 years have been put to use. The monthly data sequence is available for each month from 1970 onwards.

National Accounts: The data on nominal and real GDP, GDP deflator, regular surplus and interest payments have been obtained from the websites of the Office of National Statistics (ONS) and Her Majesty’s Treasury (HMT).

5.2 Data selection

This subsection discusses the criteria for data selection.

1. Nominal debt sequence: From the BGSD dataset, those securities are selected that have been issued on and after 1964, for which there is complete data available on amount of debt issued at the “date of issue”, coupon rate, actual date of redemption. Depending on the criteria the securities selected are restricted to those issued between 1964-2009. Accordingly for each security the average amount outstanding at the date of issue is selected. Next for the selected security the given coupon rate is used to calculate the coupon payment due until the redemption date.
2. Indexed debt sequence: The British government started issuing inflation-indexed gilts (IIG) from 1981 and hence the sequence for IIGs looks at data from the BGSD from 1981 to 2009. The IIG issued by the government are indexed to the Retail Price Index (RPI) and the data for IIG have been adjusted accordingly. For these securities the nominal coupon payments due at each date is considered. Next they are adjusted for inflation and added to the principal amount that is due at the redemption date. Finally a cash flow model is prepared that shows for each issue year the amount of cash payable by the government until the year of maturity. This sequence is then adjusted for inflation which then provided the required $s_{t+j}^I$ for the analysis.  

3. The monthly forward curve data from the Bank of England website provided the required nominal yields. From the database (Nominal government forward rates) those yields where selected that matched the “date of issue” and the “maturity” of the securities selected from the BGSD dataset. In the case of a missing yield data it was substituted by the nearest available yield for that year otherwise the yields were taken to be zero.

4. For the National Accounts the data pertaining to GDP (Nominal and Real), GDP deflator, Retail Price Indices (RPI), total government spending, total receipt of the government, interest payment of the government, interest receipt of the government, net investment of the government, capital transfer payment have been selected matching the years from the subset of the BGSD data for securities.

6 Results

This section presents the results from the decomposition of the debt-GDP ratio between 1984-2009, by further sub-dividing the 25 year period into the following sub-periods: 1984-1991, 1991-1995, 1995-2002, 2002-2009. The division into sub-periods helps analyze how the debt-to-GDP has

\footnote{See appendix for the definition of $s_{t+j}^I$}
evolved over those periods and in particular how the change relates to its components: nominal return, inflation, GDP growth rate and primary deficit. Table 1, shows the results of the analysis. Table 2 shows the contribution of the components by maturity of the debt.

The period 1984-1991, coincides with the second term of Margaret Thatcher as the Prime Minister of UK and the ‘Lawson boom’ and the entry of UK into the Exchange Rate Management system (ERM). During this period the Conservative government was pursuing a fiscal policy where income taxes were reduced thereby boosting aggregate demand. Following the stock market crash of 1987 the interest rates were kept low that in turn helped fuel a housing boom. The growth rate during 1988-89 was about five percent a year which was twice the long run trend. In the face of such events inflation started to rise and reached to about 11 percent in 1990. And it was then that Chancellor Lawson proposed and the UK entered the ERM arrangement, that required the pound sterling to be maintained within a certain bound against the German Mark. The ERM arrangement worked against the UK specially in the face of high inflationary pressure as the government tried hard to protect the value of its currency and in turn resorting to increasing the interest rate. This move in effect hurt the mortgage payers thereby raising the housing repossessions and a fall in the housing prices and finally leading the economy towards a recession.

In Table 1, looking at the debt-to-GDP ratio in the above back drop it is seen that during 1984-1991 there is a fall in the debt-to-GDP ratio from 26.8 to 5.5 percent, a drop of 21.3 percent. Of this 21.3 percent, 8.1 percent is attributable to nominal return, 5.7 percent to inflation, 6.1 to GDP growth and 17.2 percent to primary surpluses. Although the nominal return percent was high, a high inflationary figure of 5.7 percent resulted in a real rate of interest of 2.4 percent. As a result, in real terms the government had to pay less as interest payments and on account of the primary surpluses much of the debt during that period could be retired. Therefore, the reduction in the debt to GDP during this period was largely thanks to the primary surpluses and the low real interest rate payment. The following figure shows the decomposition of the debt-GDP ratio between 1984 and 1991. Clearly it was the path of nominal return and primary surplus that affected the evolution of the debt-GDP ratio in the above mentioned period.
The next period in Table 1, 1991-1995, marks the term of Prime Minister John Major of the Conservative party. During the early 90s maintaining the value of the pound in the exchange market was becoming increasingly difficult that forced the government to use the foreign currency reserves to buy the pounds that were being sold in trillions. At the time the government even raised the interest rate to 15 percent hiking it up from 10 to 12 to 15 percent in order to save a falling pound sterling. This worst hit the housing market and the economy and ultimately saw the government abandoning the ERM that cost the Treasury an estimated 3.4 billion pounds of taxpayer money. This move helped the economy recover, with the government directing the Bank of England to target inflation at 2.5 percent and the subsequent independence of the Bank in 1997.

During this period when the economy was hit by a recession the debt as a percent of GDP rose by 16.9 percent. Comparing the components that sum up to the change in the above debt-to-GDP figure it is observed that inflation and GDP growth had only 1.8 and 2.3 percent, respectively, to contribute to the growth in the stock of debt. Nominal return and a primary deficit stood at 4.1 and 10.1 percent, respectively, as their share towards the debt ratio. However, with an inflation of 1.8 percent the interest payments in real terms by the government was to the tune of about 2 percent, so that the burden of debt could not be attributed solely to interest payments. The following figure depicts the cumulative sum of the components that affected the debt-GDP ratio between 1991 and 1995. It is evident from the figure that most of the action is due to the path of nominal returns and primary deficit.
The period, 1995-2002, witnessed the coming to power of the Labour party led by Tony Blaire and during his 10 years in office the economy recorded a growth rate of about 4 percent for 40 quarters. The Labour government economic policies also included tax cuts like their predecessors.

During this period from Table 1, it is seen that the debt-to-GDP ratio had fallen by 12.7 percent of which the share of nominal returns was 12.4 percent, inflation 3.5 percent, GDP growth rate 4.5 percent and that of primary surplus being 16 percent. Therefore, it was primarily the primary surplus that helped reduce the burden of marketable public debt by 12.7 percent between 1995 and 2002. The following figure depicts the decomposition of the debt-to-GDP for the period in discussion and compared to other components primary surplus stands out as an important factor affecting the debt-GDP ratio between 1995-2002.
In the next period under consideration, 2002-2009 (refer Table 1), Gordon Brown assumed office as Prime Minister and also marks the beginning of the recession of 2008. During this period, the debt-to-GDP rose by 18.7 percent of which 5.9 percent was due to nominal returns, and inflation, GDP growth and primary deficit accounted for 3.1, 1.4 and 5 percent, respectively. However, these marketable components do not add up to the change in the debt-to-GDP ratio for this period. Since the analysis focuses only on the marketable portion of the central government debt it could be the case that the components of the non-marketable portion of the debt, in the form of nominal returns, inflation and GDP growth rate can explain the rest. As the UK became an inflation-targeting nation since the early 90s, inflation could not have risen beyond the stipulated range, also the GDP growth rate was low on account of the recession. Therefore, the only remaining component could be the nominal return on the non-marketable portion of the debt that may have helped raise the debt-to-GDP ratio between 2002 and 2009. The following figure shows the decomposition of the components for the marketable portion of the debt.

Figure 7: Cumulative Sum of the Components of the Change in the Debt-to-GDP ratio

Table 2, shows the results of the decomposition of the change in debt-to-GDP when decomposing the ratio by maturity of the debt. It is observed that for the period 1984-1991, the nominal return on the longer term securities (5+ years) was 5.1 percent and the corresponding figure for inflation was 2.5 percent, so that the real interest rate on the longer term securities stood at 2.6 percent. Comparing the real interest rate on the “5+ years” with the “2-4 years” it is seen that the former category was getting a lower rate in real terms than the latter as the figures are respec-
tively, 2.6 percent and 2.8 percent. Therefore, it was the long term bond holders during the period 1984-1991, who were being the worst hit.

During the period 2002-2009, from Table 2, a similar pattern is observed as in the period 1984-1991, where the long term bond holders, “5+ years” maturity, were receiving a real rate of return of 0.7 percent whereas the corresponding figure for the “2-4 years” maturity was 1.2 percent. Therefore, although the term structure result, whereby longer term securities end up paying higher returns than short term ones, in essence holds for the nominal returns is seen to be violated when considering the result in real terms. ³

Figure 8, below shows the paths of nominal pay outs by maturity, where the pay outs are seen to be negative for the longer term securities. The variability is also observed to be higher for the longer-term securities when compared to their shorter counterparts. And also it is seen that the pay outs decrease for all the securities in absolute value around 2000.

![Figure 8: Decomposition of the Nominal Payouts by Maturity](image)

Comparing the returns on the nominal gilts and the inflation-indexed gilts, it is observed from figure 9 that the variability on the indexed securities have been much higher than their nominal counterparts. Also it is observed that the return on indexed gilts decreased beyond 1999. ⁴

³From Table 2, the real return on “2-4 years” maturity is given by 2.3-1.1=1.2 and the real return on “5+ years” maturity is given by 2.8-2.1=0.7

⁴The British government started issuing inflation-indexed securities from 1981 and hence the return on indexed securities appear flat before the year 1981.
7 Comparison: US and UK

A similar analysis can be applied to the United States of America that presently faces a debt to GDP ratio of 97 percent after the recession of 2008. In order to compare the case of USA and UK, the analysis is undertaken for the period, 1981-2008, using the Center for Research in Security Prices (CRSP) data for government securities. Table 3, represents the decomposition of marketable debt into its components, namely, nominal return, inflation, GDP growth rate and primary deficit. Table 4 goes a step further and shows the decomposition of the change in debt to GDP into nominal returns, inflation and GDP growth rate by maturity structure of the debt.

7.1 Debt decomposition for the US: 1981-2008

From Table 3, between 1981 and 1989, when President Ronald Reagan was in office, the debt to GDP ratio during this time period is seen to have gone up by 15.2 percent. Of this increase, 25.5 percent is attributable to payments in terms of nominal returns, 8.9 percent was on account of inflation on the marketable portion of the debt. The corresponding figure for GDP growth rate and primary deficit was 8.3 and 12.5 percent respectively. From Table 4, the real returns on the “1 year” bonds, “1-4” years and “5+” years have been positive. Therefore, during the period under consideration it was mostly on account of interest payments that there was an overall increase in
the debt to GDP ratio.

During, 1989-1993, under the Presidency of G.H.W Bush, again from Table 3, the debt to GDP ratio is observed to rise by only 10.1 percent. Of this increase, 16.6 percent was on account of nominal returns on the debt with the corresponding figure for inflation, GDP growth rate and primary deficit being 5.4 percent, 4.1 percent and 5 percent, respectively. Once again the real returns on the bonds of various maturities have been positive, as is seen from Table 4.

Therefore, overall between 1981 and 1989, the debt to GDP ratio was affected mostly by the interest payments. This was the time when Paul Volcker was the Governor of the Federal Reserve when the inflation was brought down and the bond holders received a positive real return from their investment. This was unlike in the past, namely during the 1970s when long-term bond holders received negative real returns.\(^5\)

Turning to the Clinton years between 1993 and 2000, from Table 3, the debt to GDP ratio is observed to have been reduced by 16.6 percent. The component that mostly helped reduce the debt was the primary surplus comprised of 12.2 percent of the change in the debt to GDP ratio. Also during this period, the contribution of GDP growth rate had been 12.2 percent. Checking the situation of real interest it is observed that it had remained positive for all bond holders. Noticeably, from Table 4, the real return on all bond holders had gone up from the previous period, 1989-1993. Therefore, despite positive and comparatively higher positive real interest payments the debt during the Clinton years had come down mostly on account of primary surplus generation and the GDP growth rate.

Between 2000 and 2004, with a Republican G.W. Bush in office, the debt to GDP ratio is observed to have gone up by two percent. Of this increase nominal return contributed by eight percent and the next major player was the GDP growth rate with a contribution of 3.5 percent. During the period under consideration there was a small surplus generation on the primary account

\(^5\)Hall-Sargent (2010) presents the debt decomposition for USA between 1945-2009, where they show that during the periods immediately after World War II, the long-term bond holders received negative real returns.
that may have helped retire some the debt. From Table 4, the real return on all bond holders is observed to be positive with the real returns progressively higher on the longer term securities.

Finally during the last term of President Bush, 2004-2008, the debt to GDP is observed to have increased by 10.4 percent. The contributions of the components being in the order of 6.7 percent, 3.7 percent, 3.1 percent and 8.3 percent on account of nominal returns, inflation, GDP growth rate and primary deficit, respectively. With the low GDP growth rate and inflation maintained at a modest level it was mostly on account of the primary deficit and positive real returns that affected the increase in the debt to GDP ratio. Comparing the real interest rates on the bonds of various maturities between the last two periods it is observed, from Table 4, that the real returns have gone down for all bond holders.\(^6\)

Therefore, overall it is observed that a major factor that had contributed to the change in the debt to GDP in the sub-periods between 1981 and 2008 have been the nominal return of the US government debt. Another factor that also did play some role was the primary surplus position that contributed in bringing down the debt by helping the government repay part of the debt. During the sub periods under consideration GDP growth rate did play some role, especially during the Clinton administration. Inflation, however, did not play much role although as Hall-Sargent (2010) point out overall GDP growth rate did play an important role between 1941 and 2009 in affecting the debt to GDP ratio.

### 7.2 Comparison of debt decomposition: US and UK

Decomposing the debt to GDP ratio for the US and UK between 1980 and 2009, a similar pattern is seen to evolve in terms of the components that have played an important role in affecting the ratio in any particular year.

\(^6\)During 2000-2004, from Table 4, the real returns on “1 year” bond holders was 1.7-1.1 = 0.6 percent, for “2-4 years” bonds, it was 2.2-0.9 = 1.3 percent and that for “5+ years” bonds, it was 4 - 0.8 = 3.2 percent. By similar calculations, the real returns on the “1 year”, “2-4 years” and “5+ years” bonds were 0.2 percent, 0.5 percent and 2.2 percent, respectively. Therefore, the drop in the real returns for the longer term bond holders was the highest.
Liquidation of debt via inflation has been practiced in the US during the years immediately after World War II (Hall and Sargent, 2010) and in the UK, prior to years when it started targeting inflation in the early 90s. However, with the onset of the period of Great Moderation that witnessed a reduction in inflation in most industrialized nations, the use of inflation as a means to liquidate the high level of debt has become less popular. So that post mid-90s (refer Table 3), the contribution of inflation in affecting the evolution of the debt to GDP ratio has been falling. A similar pattern is seen for the UK (refer Table 1), where the share of inflation has been falling as a component affecting the change in the debt to GDP ratio.

Interest payments play an important role in affecting the change in the debt to GDP ratio. As a component affecting the debt-GDP ratio it was a significant component for both the countries. Interest payments in nominal terms was comparatively high for the US from the 80s until 2000 (refer Table 3) and for the UK in almost all the periods between mid-80s until 2009 (refer Table 1). However, the severity of the impact of high interest payments to service the debt was reduced due to the expansionary monetary policy in place in both the countries that helped maintain the nominal interest rate close to zero.

One component where the two countries diverge in terms of significantly affecting the evolution of the debt-GDP ratio is primary deficit for the time period 1980-2009. Whereas, during the Clinton years (1993-2000) in the US, the generated primary surplus did help in repaying the debt, in the UK, for three consecutive periods, starting 1984-2000, (refer Table 1), the state of primary account had played a decisive role in the evolution of the debt-GDP ratio. So that for the UK, a surplus in the primary account of the government budget helped reduce debt between 1984-1991 and 1995-2002, and added to the debt-GDP ratio due to primary deficit in the period 1991-1995.

8 Conclusion

To summarize the results of the decomposition of the change in debt-to-GDP point it is observed that for the United Kingdom the government did inflate away part of the debt burden and thereby
succeeded at times in keeping the interest payments low in real terms. Around the mid-90s UK started targeting inflation and that helped stabilize the variation in inflation. However, circa 2000, the interest rate on nominal and indexed securities have been falling so that for the government the burden of interest payments have been low. Therefore, even though the government may not have been able to use inflation to liquidate the stock of debt once inflation-targeting was in place, the fact that interest rates were low helped reduce the debt service on account of interest payments. Hence it may not be wrong to conclude that “financial repression” in the form of inflation and lower interest rates did come into play in some periods, mid-80s to early 1990s and post 2000, alluding to the findings of Reinhart-Sbrancia (2011).

The decomposition exercise reveals that in most of the periods under consideration, primary deficits or surplus as the case may have been, did play an important role in affecting the change in debt-to-GDP ratio. Given the state of demographics in the UK and the mounting social expenditure that the aging population entails seems to confirm the findings of the present exercise. This result conforms with the findings of Scott-Giannitsarou (2006). Therefore, with proper austerity measures in place the British government may succeed in liquidating the debt stock. However, such austerity measures have implications for the overall dynamics of the economic system.

Comparing the situation of UK with the US over the same period reveal similar pattern in the policy design of the government as a means to tackle the deteriorating public finance situation. Therefore, such practices undertaken by the governments are not just similar across time but also similar across nations facing identical economic conditions. With the changing terrain of demographics that call for austerity measures, one wonders if such steps are sustainable over a longer time horizon and also if fiscal policy of such nature have implications for the monetary policy. Fiscal policy has implications for the scope of monetary policy in affecting the dynamics of the macro fundamentals. Therefore, despite UK’s inflation-targeting and the subsequent declaration of the Bank of England as independent during the mid-90s, it appears that the government may have lost an instrument in the form of inflation to affect the debt level. However, as Leeper (1991, 2010) points out, monetary policy to have an impact on prices requires proper backing from the fiscal policy. Therefore, in the face of mounting debt, that implies, an active fiscal policy regime
it is important to realize that monetary policy cannot actively pursue the macro objectives that is required to anchor the expectations of the economic agents. Hence the need for a harmonized interaction between the fiscal and monetary policies.

As the Fiscal Theory of the Price Level (Woodford, 1994) points out, whereby, the real value of the government debt should equal the expected present value of fiscal surpluses, it is important that the government raise debt that is backed by future surpluses and thereby having a target debt level that is sustainable. In the absence of such target, there are chances of surprise inflation that may come into play and help the government liquidate the debt. Therefore one direction for future work could be to see how much of the inflation that was in place was due to targeted inflation and how much of it was on account of surprise inflation.
A Appendix

This section provides the details of the equations used in the analysis and also the details of the variables employed. Section B provides the derivation for the basic accounting equation and section C introduces the variables used to fit into the basic accounting equation (equation (1) in the main text).

B Derivation of equation (1)

The government budget constraint is given by:

\[ b_t = b_{t-1} + r_{t-1,t}b_{t-1} + g_t - \pi_t - S_t \]

where,

- \( b_t \) is the nominal debt at time \( t \).
- \( g_t \) is the government expenditure at time \( t \).
- \( S_t \) is the seigniorage at time \( t \).
- \( r_{t-1} \) is the nominal rate of return between time \( t \) and \( t-1 \).
- \( \pi_t \) is the lump-sum tax at time \( t \).

Re-writing the above in real terms leads to the following:

\[ \frac{B_t}{Y_t} = \left[ \frac{(1 + r_{t-1,t})}{(1 + \pi_{t-1,t})(1 + g_{t-1,t})} \right] \frac{B_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t} \]

For small \( \pi \) and \( g \),

\[ \frac{(1 + r_{t-1,t})}{(1 + \pi_{t-1,t})(1 + g_{t-1,t})} \approx (1 + r_{t-1,t} - \pi_{t-1,t} - g_{t-1,t}) \]

Hence using the approximation, the government budget constraint in real terms is given by the following equation:

\[ \frac{B_t}{Y_t} = (1 + r_{t-1,t} - \pi_{t-1,t} - g_{t-1,t} - 1) \frac{B_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t} + \frac{B_{t-1}}{Y_{t-1}} \]

Finally, the basic equation used in the analysis:
\[
\frac{B_t}{Y_t} = (r_{t-1,t} - \pi_{t-1,t} - g_{t-1,t}) \frac{B_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t} + \frac{B_{t-1}}{Y_{t-1}}
\]

C Variables

\(S^t_{t+j}\) → number of time \(t + j\) pounds that the government has at time \(t\) promised to pay.

\(q^t_{t+j}\) → number of time \(t\) pounds it takes to buy a pound at time \(t + j\) such that :

\[q^t_{t+j} = \frac{1}{(1 + \rho_{jt})^j}\]

where \(\rho_{jt}\) is the time \(t\) yield to maturity on bonds with \(j\) periods to maturity.

Let \(p_t\) is the price level in base year pounds and \(\nu_t\) is the value of the currency measured in goods per pounds. Thus \(\nu_t = \frac{1}{p_t}\).

\(\bar{S}^t_{t+j}\) → number of time \(t + j\) pounds that the government has at time \(t\) promised to pay.

Accordingly for inflation-indexed bonds, the corresponding return is given by \(q^t_{t+j} = \frac{1}{(1 + \bar{\rho}_{jt})^j}\)

where \(\bar{\rho}_{jt}\) is the time \(t\) yield to maturity on real bonds with \(j\) periods to maturity.

\(def_t\) is taken to be the government’s real net-of-interest budget deficit measured in units of time \(t\) goods.

C.1 Accounting equation

Recall equation (2):

\[
\frac{\tilde{B}_t + \tilde{B}_t}{Y_t} = \sum_{j=1}^{n} r^j_{t-1,t} \frac{\tilde{B}^j_{t-1}}{Y_{t-1}} - (\pi_{t-1,t} + g_{t-1,t}) \frac{\tilde{B}^j_{t-1}}{Y_{t-1}} + 
\sum_{j=1}^{n} r^j_{t-1,t} \frac{\tilde{B}^j_{t-1}}{Y_{t-1}} - g_{t-1,t} \frac{\tilde{B}^j_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t} + \frac{\tilde{B}_{t-1} + \tilde{B}_{t-1}}{Y_{t-1}}
\]

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In terms of the variables defined in section C equation (2) can be re-written as:

$$\sum_{j=1}^{n} \nu_t q_{t+j}^{l} q_{t+j}^{l} = \sum_{j=1}^{n} \left( \frac{\nu_t q_{t+j-1}^{l} Y_{t-1} - 1}{\nu_{t-1} q_{t+j-1}^{l} Y_{t-1}} \right) \frac{\nu_{t-1} q_{t+j-1}^{l}^{l} + \sum_{j=1}^{n} \nu_{t-1} q_{t+j-1}^{l} s_{t+j}}{Y_{t-1}}$$
References


## Table 1: Contributions to Changes in the Debt-GDP Ratio

<table>
<thead>
<tr>
<th>Period</th>
<th>Debt to GDP</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>1984</td>
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</tr>
<tr>
<td>1991</td>
<td>5.5</td>
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<tr>
<td>1995</td>
<td>22.5</td>
<td>9.8</td>
</tr>
<tr>
<td>2002</td>
<td>9.8</td>
<td>28.4</td>
</tr>
</tbody>
</table>

Notes:
Column (3) = Column (2) - Column (1).
Column (3) is approximately the sum of columns (4) through (7).
<table>
<thead>
<tr>
<th>Period</th>
<th>Debt to GDP</th>
<th>Nominal Returns</th>
<th>Inflation</th>
<th>GDP Growth</th>
<th>Deficit to GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start</td>
<td>End</td>
<td>All 1 yr.</td>
<td>2-4 yrs.</td>
<td>5+ yrs.</td>
</tr>
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<td>1984</td>
<td>1991</td>
<td>26.8 5.5</td>
<td>-21.3</td>
<td>12.4</td>
<td>-3.8</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>2.4</td>
<td>4.9</td>
<td>5.1</td>
</tr>
<tr>
<td>1991</td>
<td>1995</td>
<td>5.5 22.5 16.9</td>
<td>7.4</td>
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<td>1995</td>
<td>2002</td>
<td>22.5 9.8</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>2009</td>
<td>9.8 28.4 18.6</td>
<td>5.9</td>
<td>0.8</td>
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Notes:
IIG implies Inflation-Indexed Gilts.
Column (3) = Column (1) - Column (2).
Column (4) = Sum of columns (4a) to (4c).
Column (6) = Sum of columns (6a) to (6c).
Column (7) = Sum of columns (7a) to (7c).
Column (4) is approximately the sum of columns (4), (5), (6), (7), (8) and (9).
Table 3: Contributions to Changes in the Debt-GDP Ratio for USA

<table>
<thead>
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<th>Debt to GDP</th>
<th>Components</th>
</tr>
</thead>
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<tr>
<td>1989</td>
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<td>25.4</td>
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<tr>
<td>2000</td>
<td>25.4</td>
<td>27.4</td>
</tr>
<tr>
<td>2004</td>
<td>27.4</td>
<td>37.8</td>
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</table>

Notes:
Column (3) = Column (2) - Column (1).
Column (3) is approximately the sum of columns (4) through (7).
### Table 4: Contributions to Changes in the Debt-GDP Ratio Decomposed by Maturity of Debt for USA

<table>
<thead>
<tr>
<th>Period Start</th>
<th>Period End</th>
<th>Change</th>
<th>Debt to GDP</th>
<th>Nominal Returns</th>
<th>Inflation</th>
<th>GDP Growth</th>
<th>Deficit to GDP</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td>All 1 yr. 2-4 yrs. 5+ yrs. TIPS</td>
<td>All 1 yr. 2-4 yrs. 5+ yrs. TIPS</td>
<td>All 1 yr. 2-4 yrs. 5+ yrs. TIPS</td>
<td>All 1 yr. 2-4 yrs. 5+ yrs. TIPS</td>
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</tr>
<tr>
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<td>15.2</td>
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<td>0 -8.8</td>
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<td>0</td>
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<td></td>
<td>9.8</td>
<td>8.6</td>
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<tr>
<td>1989 1993</td>
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<td>16.7</td>
<td>0 -5.4</td>
<td>-4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4.2</td>
<td>5.6</td>
<td>6.9</td>
<td>-2 -1.9 -1.5</td>
<td>-1.5 -1.4</td>
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<td></td>
</tr>
<tr>
<td>1993 2000</td>
<td>25.4</td>
<td>-16.6</td>
<td>19.6</td>
<td>0 -5.6</td>
<td>-11.6</td>
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<td>-2.1 -2 -1.5</td>
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</tr>
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<td>2000 2004</td>
<td>27.4</td>
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<td>-0.1</td>
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<td>1.7</td>
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<tr>
<td>2004 2008</td>
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<td>0.1 -3.7</td>
<td>-3.1</td>
<td>-0.1</td>
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<tr>
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<td>1.6</td>
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<td>-1.4 -1.2 -1.1</td>
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<td>-0.9</td>
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</tr>
</tbody>
</table>

**Notes:**
- TIPS stand for Treasury Inflation Protected Securities.
- Column (3) = Column (1) - Column (2).
- Column (4) = Sum of columns (4a) to (4c).
- Column (6) = Sum of columns (6a) to (6c).
- Column (7) = Sum of columns (7a) to (7c).
- Column (4) is approximately the sum of columns (4), (5), (6), (7), (8) and (9).