

Managing the UK National Debt 1694-2017 – III Debt Management

Over the last couple of years Martin Ellison and I have created a historical database of UK government debt. A number of authors have made extensive use of the fact that we have more than 300 years of public finance data for the UK. Our contribution has been to create a database for the *market value* of UK government debt, based on the individual market price of each bond.

In this blog we focus on what lessons we can learn about the operation of UK debt management from this dataset.

Introduction

A key feature of our data is that it is built up by using the price and quantity data for each *individual* bond. This means we can perform counterfactual simulations that answer the question what would government debt be today if the UK government had issued different types of debt in the past. Because bonds of different maturities have a different yield and because their price correlates in different ways with macroeconomic variables, different debt issuance strategies will lead to different levels of debt.

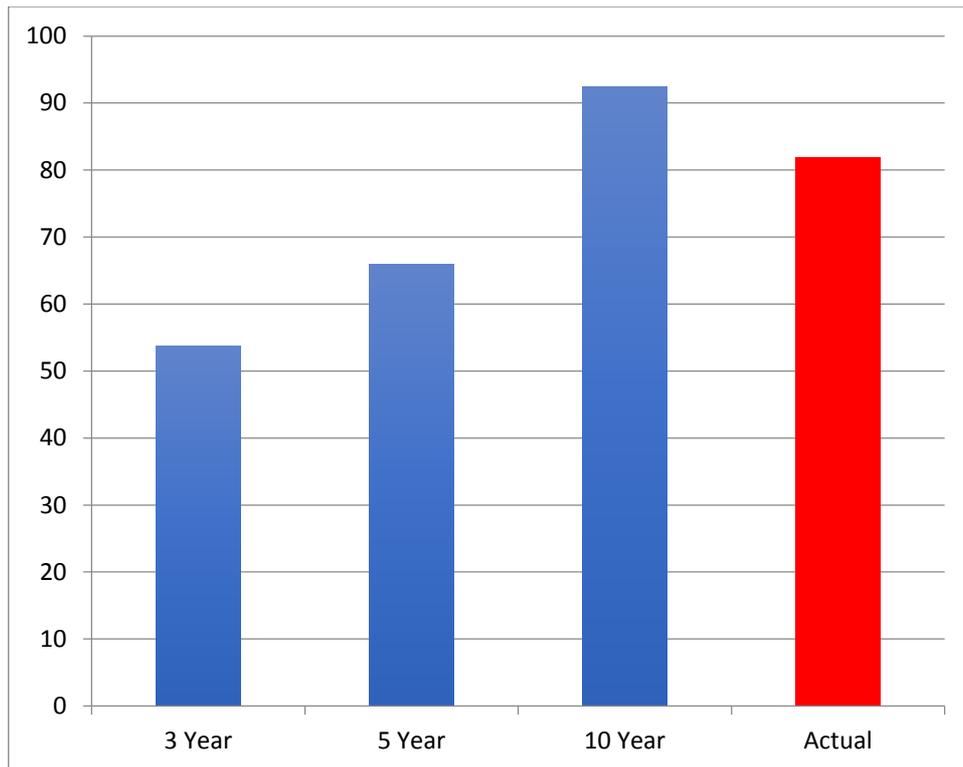
In order to perform these counterfactuals we need to estimate a yield curve and this limits us to the period 1914 and 2017. Before 1914 the government doesn't issue bonds of enough different maturities to enable us to do this. This leaves us with a 100 years of data including multiple business cycles, two world wars and a major financial crises.

It Pays to Go Short

UK government debt has the longest average maturity of any country in the world and at 15.4 years it is more than 10 years longer than for the US. What would have happened if the UK government had instead issued debt of shorter maturity?

To answer this question we perform the following simple experiment. Let us go back in time and assume that the government still runs the same primary deficit (excluding interest payments) and that GDP and inflation all remain the same. However, instead of issuing the debt it actually did we assume that the government only ever issues debt with a maturity of three years. In other words, every year the government finances its deficit and refinances its maturing debt by only issuing three year bonds. Further, we make the strong assumption that it can do this at the price of three year bonds that we observed historically. We then track what this alternative debt management strategy means for the debt/GDP ratio at the end of our sample. We also perform this experiment for when the government only issues 5 year and 10 year bonds.

- *Issuing short bonds would have led to debt being lower by 28% of GDP at end of 2016.*



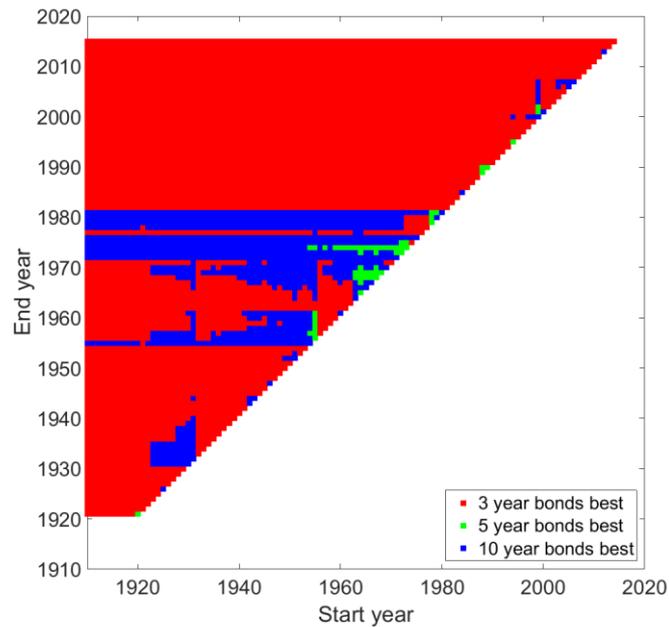
Level of Debt/GDP (%) in 2016 Under Different Debt Management Policies 1914-2016

As shown above the results are clear – issuing only three year bonds every year would have produced a dramatically lower level of debt. Under this 3 year issuance policy, debt at the end of 2016 would have been 53.8% of GDP rather than the actual 81.9%.¹

The reason for this outperformance is simple. Most of the time the yield curve slopes upwards so that yields on long bonds are higher than on short bonds. Therefore a policy that always issues short bonds performs better than a policy focused on long bonds.

Comparing the whole period 1914 and 2016 may be misleading. Even if by the end of 2016 the three year issuance case outperformed other policies, this may just reflect events at the end of our sample period or be affected by one particular sub-period. To investigate the robustness of our results we look at every combination of dates between 1914 and 2016 and see how many times a policy of issuing 3 year bonds outperforms issuing longer bonds. The result is shown below where red/green/blue shows when 3/5/10 year bonds outperform. As the Figure clearly shows issuing short bonds outperforms longer bonds a majority of times.

¹ We perform this counterfactual only on the nominal debt and exclude index linked debt, hence the debt level numbers differ from those for total debt.



Only in the period from 1960 to 1980 does issuing long bonds frequently dominate short bonds. This is mainly due to the higher inflation of this period, which led to larger falls in the price of long bonds and reductions in the value of government debt.

Liquidity Effects

There are currently 73 distinct types of UK government bonds outstanding. Our counterfactual instead shows how debt would have been lower if the government had simply issued three year bonds. Why does the government issue so many different bonds?

One problem with focusing issuance on just one type of bond is liquidity effects. There is a fear that if the government tries to issue large quantities of a particular bond then its price will fall and its yield increase, making that borrowing more expensive. Spreading issuance across various maturities alleviates these costs.

- *To benefit from the gains of lower interest rates our counterfactuals require issuing the same bonds in very large volumes, e.g. issuing annually three year bonds worth 15.2% of GDP compared to the 0.8% of GDP that were actually issued*

Our main result is that the level of government debt would have been reduced by 28% GDP if the government had only issued three year bonds over the period 1914-2016. This does however require issuing around 15.2% of GDP each year as three year bonds, compared to the 0.8% of GDP that were sold under observed policy. If this larger scale of issuance increased the yield on three year bonds by more than 85 basis points each year then the benefits of just issuing 3 year bonds disappear.

- *Based on experience under Quantitative Easing, even allowing for bond prices falling in response to such large issuance it would still be cheaper to issue three year bonds*

For these liquidity effects to nullify the cheapness of short debt it needs that a doubling of issuance of 3 year bonds would increase yields by 4.9 basis points. This is more than twice what estimates from the government's experience with Quantitative Easing suggests. It is also worth noting that, even if these liquidity effects exist, the next most obvious policy is to issue 2 and 4 year bonds as these will have lower yields than 10 year bonds.

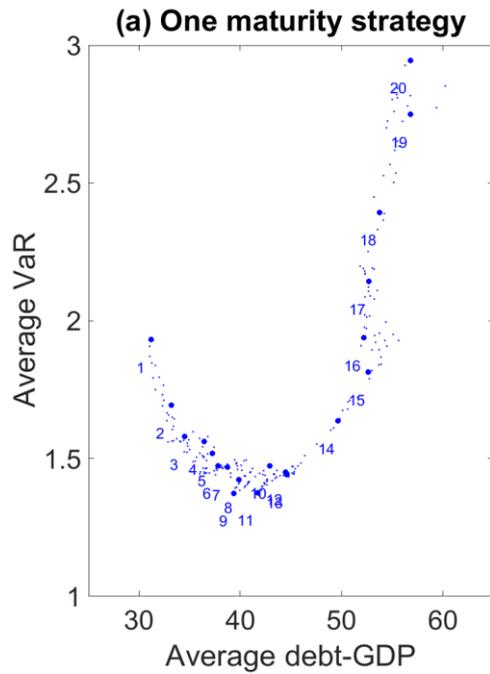
Putting All Your Eggs in One Basket

Another problem with focusing issuance on just a single maturity is that this creates a reoccurring rollover and refinancing risk. Three years after every large deficit the government will find itself having to refinance a large amount of debt, leaving it exposed to the risk of higher interest rates.

To investigate refinancing risk we imagine that the government decides what debt it will issue one month ahead. This makes it vulnerable to fluctuations in market prices so that a bond auction could produce less revenue than was expected. We calculate the shortfall in financing as a % of GDP if bond price movements fall to their 5th most unfavourable percentile in a month's time - a 5% Value at Risk (VaR) measure. We then examine the performance of different debt management strategies in achieving low levels of debt *and* rollover risk (as measured by VaR).

Because the yield curve usually slopes upwards, issuing short maturity bonds leads to better outcomes in terms of the level of government debt. However, issuing only short bonds means that every period a lot of debt has to be refinanced. In the extreme case of only issuing one year bonds, the government has to refinance the entire stock of debt every year. Issuing long bonds therefore spreads out the rollover risk. Long bond prices are though more volatile than short bonds and so relying on long bonds will provide additional VaR.

- *Relying on short bonds substantially reduces the level of debt in the long run but requires very high volume of issuance each period. This substantially increases rollover risk of debt. Issuing 9 year bonds only would have minimised rollover risk.*

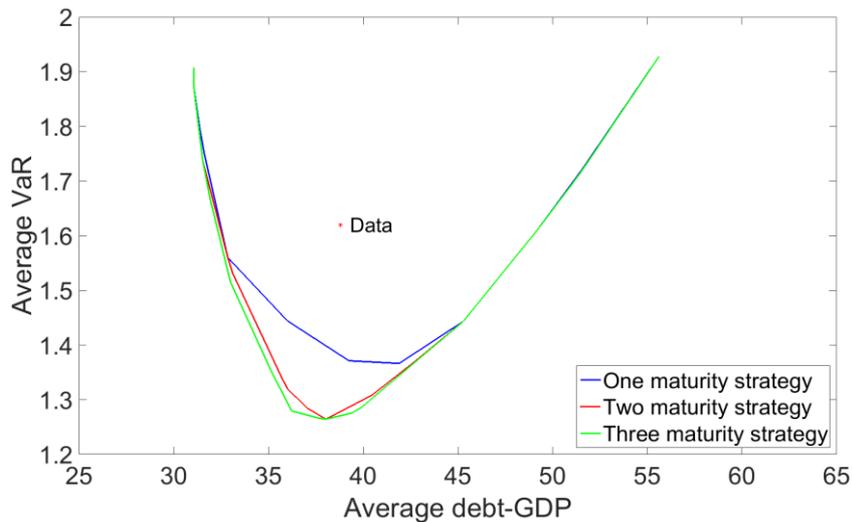


These contrasting influences can be seen above. The shorter the maturity of bonds issued the lower the level of debt across the whole sample period. However, issuing just 1, 2 or 3 year bonds leads to higher VaR due to the high amount of debt being rolled over every year. Issuing longer maturity debt leads to a higher debt/GDP ratio but reduces VaR until maturity reaches 9 years, after which point the volatility of bond prices means that VaR increases and the higher bond yields mean that the debt/GDP ratio increases too.

It Takes Two

Maintaining bond issuance to just one maturity is restrictive and giving the government the option of issuing bonds of several maturities is likely to improve the trade-off between reducing the level of debt and minimising risk. We investigate the scope for alternative debt outcomes by assuming that the government issues fixed proportions of two and three different maturity bonds.

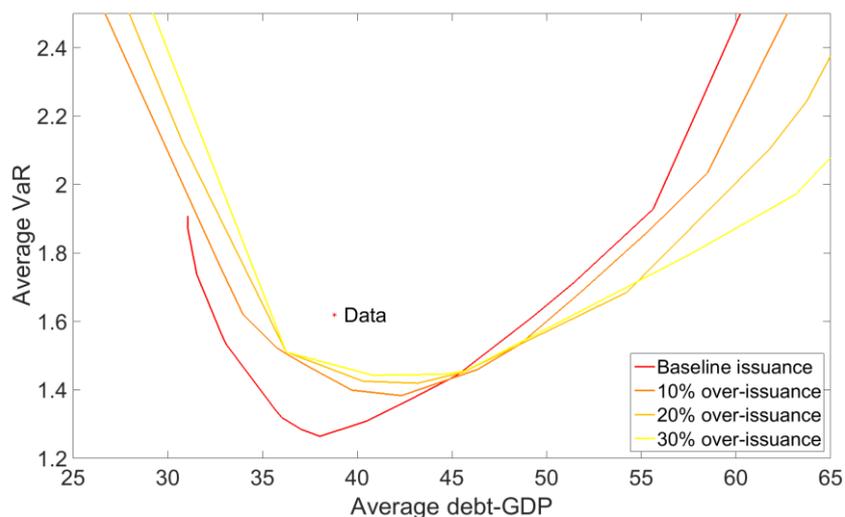
- *Allowing the government to issue two bonds of different maturities reveals that the best performing portfolio in terms of rollover risk consists of 65% of 3 year bonds and 35% of 12 year bonds. This produces an even lower debt/GDP ratio of 38%.*



Issuing three distinct bonds provides little additional in the way of better outcomes to two maturities, but two clearly outperforms just one, enabling lower levels of debt for the same amount of risk or less risk for the same debt outcome. The minimal VaR in the two bond counterfactual is a portfolio where the government issues around 65% 3 year bonds each period and 35% 12 year bonds. In other words, long bonds help reduce VaR through reducing the amount of debt the government has to issue each period, but the best performing portfolio still involves the government issuing a large proportion of short term 3 year debt.

Leverage

All of our counterfactuals so far have assumed that the government issues debt of different maturities. In the academic literature a common recommendation is that the government should issue more debt than it requires and invest the surplus in assets. These leveraged positions are recommended in order to better exploit the limited variations in the yield curve.



- *Leveraging does not make long bonds more attractive. It holds out the prospect of even lower levels of debt/GDP by over-issuing short bonds but at the cost of much higher rollover risk.*

To investigate the impact of leverage we show above how over-issuance of debt (by 10, 20 and 30%) enables the government to achieve different outcomes. Focusing on over-issuance of short bonds leads to the possibility of achieving even lower levels of debt to GDP (the northwest part of the chart). The government borrows at the short rate and lends at the long rate, which is profitable because of the term premium. However, whilst this produces lower levels of debt, it does so at the cost of much more elevated Value at Risk as so much debt is now being rolled over each period.

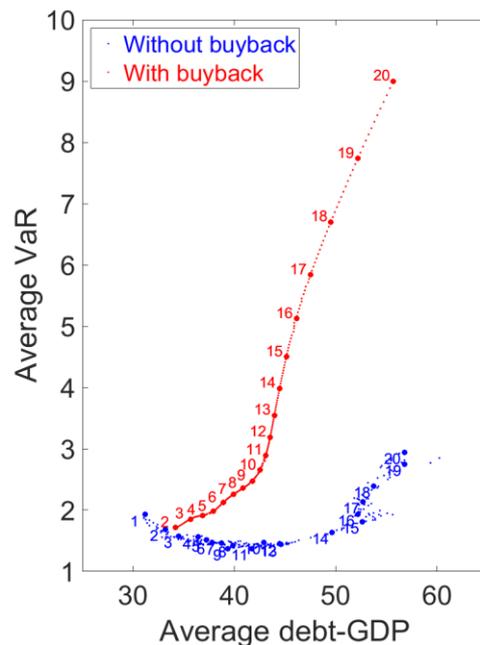
Over-issuing long bonds (northeast part of the chart) helps achieve, for any given level of debt to GDP, lower Value at Risk. However this comes at the expense of higher borrowing costs because, as the Figure shows, it also means that any given level of VaR is now attained with a higher level of debt/GDP. Most striking about this over-issuance of long bonds is that the left hand side of the Figure shows that the government can achieve exactly the same VaR for considerably lower levels of debt if it focuses issuance on short term bonds.

Buyback

The standard (implicit) assumption in the academic literature is that every period the government buys back all outstanding debt and then reissues it. In practice buying back before a bond matures is very rare – out of the 537 finite dated bonds in our sample this happens only 8 times.

Why would a government buyback its debt each period? Buyback means that long bonds remain long bonds for longer, i.e., they don't see their maturity shrink each year, and so buyback helps better exploit any appealing features of long bonds. Buying back in such large quantities is also likely to be very expensive if there are transaction costs or liquidity effects, but in the buyback literature these are not usually considered.

- *Introducing buyback does not change our results regarding the superior ex post performance of short bonds. Buyback substantially increases issues around rollover risk without offering better debt/GDP outcomes.*



As shown above, introducing buyback does not lead to better outcomes compared to no buyback. Firstly, buyback substantially increases rollover risk as it leads to very large amounts of debt being reissued each period. Secondly, it does so whilst achieving worst debt/GDP outcomes. Funding costs remain high because buyback means the government keeps issuing long bonds and these are more expensive.

Post Crisis

What if the UK government had suddenly switched to just issuing three year bonds in 2008? In other words, what if all ongoing primary deficits and all debt being redeemed was refinanced by issuing only three year debt?

The answer is that the market value of government debt would have been 66.1% of GDP by the end of 2016 (ignoring as before indexed debt) compared to the actual outturn of 81.9%, whilst the face value would have been 60.6% compared to 63.8%. The dramatic difference in market value is not surprising given the surge in bond prices and especially long bond prices over this period. Focusing on face value reveals that debt would have been around £54bn less had the government issued short.

Our focus above has been on the central government's balance sheet. Over this period Quantitative Easing and the purchase of outstanding debt by the Bank of England obviously means that the consolidated balance sheet of the government is a much richer topic. The consequence of the Bank buying long dated debt and financing this through reserves has been to shorten the maturity of government debt, in line with the advantages of going short we analyse.

Conclusion

Examining counterfactual debt management scenarios for the UK over the period 1914 to 2016 reveals that the government would have been substantially better off issuing three year bonds each period, rather than focussing issuance on long bonds.

Had it done so, debt would have been lower by 28% of GDP by the end of the sample. This outperformance through issuing short bonds is a pervasive feature of the period and only during the sub-sample 1960-1980 would issuing 10 year bonds have done better.

The reason for the dominance of short term issuance over our sample is simple – the yield curve slopes upwards and so long bonds are expensive. In the academic literature the covariance of long bonds with adverse fiscal shocks makes them a desirable instrument of debt management. However, we find in our dataset of 100 years that long bonds rarely provide a favourable covariance and when they do it is of limited amount. Given long bonds are also more expensive the superior performance of short bonds is clear.

Taking into account other features of bond markets can reinstate a role, albeit a minority one, for long bonds. Liquidity effects might suggest issuing more than just one or two maturity bonds, although higher interest rates would still imply that long bonds shouldn't be issued. Long bonds do have a role to play in reducing rollover risk, as focusing exclusively on short bonds means a large amount of debt being issued each period. In order to minimise rollover risk we find that a portfolio of 65% 3 year debt and 35% 12 year debt should have been issued. This would also have achieved an even lower level of debt to GDP of 38%.

In essence the yield curve is very simple, it slopes upwards, doesn't show a great deal of consistent fluctuations and the end result is that issuing short term debt leads to lower borrowing costs, which in the long term leads to better debt outcomes.

If there is a rationale for issuing long maturity UK debt it must arise from factors specific to the microstructure of bond markets or other institutional considerations. Whatever those considerations are, it is worth asking if their value is greater than the gain of 28% of GDP that focusing on issuing short term debt would have achieved.

The above is a summary of our results on debt management for the UK over the last 100 years. If you are interested in the dataset or a copy of the paper "Managing the UK National Debt 1694-2017" by Martin Ellison and Andrew Scott then please email martin.ellison@economics.ox.ac.uk or ascott@london.edu.

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