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Monetary policy in over-indebted economies[*]

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Abstract

The paper explores the implications of rising non-financial sector debt and worsening fiscal prospects in industrial countries for the conduct of monetary policy. It reports evidence that fiscal policy in the United States and the United Kingdom has been adjusted so as to stabilise the public debt-to-GDP ratio. But high debt ratios make the future path of fiscal deficits more dependent on interest rate assumptions than they would be if debt were lower. To the extent that high public debt increases uncertainty about future interest rates, reducing the substitutability between short-term and long-term paper in investors' portfolio, they might enhance the effectiveness of unconventional monetary policies to influence long-term interest rates and support fiscal adjustment. The success of such a strategy, nevertheless, depends on how well monetary policy and debt management policy is coordinated, in practice.

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Introduction

The assertion that most advanced economies have become "over-indebted" has become a commonplace. Newspaper columns on how to cure the recession are full of "Keynes versus Hayek". Keynes attributed recession to deficient demand, so the remedy is to spend and increase government debt. Hayek blamed over-indebtedness fuelled by cheap credit, so the cure is to curtail spending and reduce debt.

This paper therefore explores the implications of over-indebtedness for monetary policy. High levels of indebtedness make all actors – households, companies and governments – more sensitive to changes in interest rates. Fiscal-monetary feedbacks are likely to be stronger when public debt/GDP ratios rise. Doubts about medium-term fiscal sustainability are likely to increase market uncertainty about future interest rates – and this could at some point complicate monetary policy. All this could lead to government pressure on central banks not only in their setting of the policy rate, but also in their support for government bond markets. It is this second element – the aggressive use of central bank balance sheets – that has become more prominent in this crisis. But governments could also adapt their debt management policies to address market uncertainty and volatility – and support their own markets. How they do this could matter greatly for central banks. The following paragraphs outline the paper.

Over-indebtedness is not just the result of excesses before the recent financial crisis; rather, the rise in aggregate debt/GDP ratios has been a long-run trend seen in most advanced countries (Section 1). There is no single explanation for this trend. Nor is there even a clear benchmark for over-indebtedness, particularly given the parallel rise of private sector assets. But what is indisputable is that higher indebtedness has been facilitated by a substantial secular decline in real long-term interest rates. This has lightened the burden of interest payments on debtors even as debt has grown. Governments in particular have gained. Higher levels of public sector debt – not matched by comparable levels of public sector assets – raise the well-known issue of fiscal sustainability.

Section 2 examines how far the stance of fiscal policy has, over the past 40 years, responded to debt levels. It reports econometric evidence that policy in the United Kingdom and the United States does seem to have been adjusted so as to stabilise public debt/GDP ratios. But there has been very large variation in the response over time. Of particular relevance to the current situation is that we find no evidence that higher debt/GDP ratios produced a non-linear (stronger-than-average) fiscal response. The estimated response of primary balance to debt and the degree of fiscal policy persistence are used to construct simple scenarios for the future path of public debt. Weak growth in the near term implies further significant rises in debt/GDP ratios. In the medium term, the ageing of the population will, on current policies, aggravate fiscal deficits. High debt/GDP ratios make the path of fiscal deficits more dependent on interest rate assumptions than they would be if debt were lower. As a result, high debt levels and interest rate shocks could interact in destabilising ways.

Section 3 argues that high levels of public debt, and uncertain fiscal prospects, are likely to increase uncertainty about future interest rates. This will reduce the substitutability between short-term and long-term paper in investors' portfolios. In circumstances of imperfect substitutability between paper of different maturity, changes in the mix of short-term bills and long-term bonds sold to the private sector will affect the yield curve. At the same time, changes in short-term rates have a weaker impact on longer-term yields.

Recent central bank purchases of government bonds on a large scale have sought to lower yields in government debt markets. Some present these policies as wholly exceptional – made necessary by an extraordinary crisis. In truth, such policies revive a classical debate about whether the long-term interest rate should be a policy objective for central banks. Section 4 summarises the arguments for such policies advanced by Keynes, Tobin and the Radcliffe Report.

In any event, the large-scale outright purchase of government bonds by the central bank in pursuit of macroeconomic objectives raises several obvious questions. What is the point of the government issuing paper for the central bank to hold? Would it not be simpler for the government debt manager to issue less long-term paper and more short-term paper? How does the government debt manager adjust issuance policy in response to macroeconomic signals (including to the policy actions of the central bank)? Section 5 provides some statistical evidence that US debt issuance policy (which is usually rationalised on microeconomic grounds) has actually been quite responsive to macroeconomic developments. An important issue of policy coordination thus arises).

1. "Over-indebtedness": is there a reliable metric?

The common assertion that most advanced economies are "over-indebted" presumably means that aggregate debt/GDP ratios are too high and need to fall to some lower equilibrium level. But it is not clear how to define this level.

Trends in aggregate debt

Graph 1 shows the aggregate debt of US domestic non-financial borrowers – governments as well as households and corporations – as a percentage of GDP.[1] From the mid-1950s to the early 1980s, US aggregate debt was remarkably constant around 150% of GDP – a stability highlighted notably by Ben Friedman (1982). This stability was accompanied by substantial negative co-variation in private and public debt, lending credence to a Ricardian view of the world that households increase their savings and/or pay down their debt by the present value of future taxes needed to repay government debt (Barro, 1974)[2]. Shocks could of course push the aggregate debt/GDP away from this equilibrium ratio, but the economy would soon revert to it. In short, there seemed to be a reliable metric for "over-indebtedness". But this stability came to an end in the mid-1980s, with the US aggregate debt ratio rising rapidly over the next three decades to reach 260% by 2010.

Other major industrial countries have, over the past 20 or 30 years, also seen a substantial, secular rise in the aggregate debt/GDP ratio. Graph 2 presents comparable data for France, Germany, the United Kingdom and Japan used by Cecchetti, Mohanty and Zampolli (2011b). France and the United Kingdom have, in fact, seen a more pronounced increase in their private and public debt than the United States. Both countries (as well as Germany) have seen, to various degrees, a breakdown in the stability of their aggregate debt-to-GDP ratio.

In Japan there is a strong, negative correlation between private and public debt. At the same time, it is difficult to cast Japan's experience as one of the private sector following the public sector - as one would expect in a Ricardian world. The decline in private debt has been the result of the long period of deleveraging by the Japanese firms – an adjustment required by their high debt levels in the previous decades and the bursting of the equity bubble in the 1990s. To the extent that the rise in public sector debt partly filled the demand gap in the economy resulting from corporate deleveraging, it has followed rather than led the decline in

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1 Hereafter this sum is referred to as "aggregate debt".

2 Applying a similar reasoning to corporate debt, individuals view the debt incurred by the companies they own as their own liabilities; see David and Scadding (1974).

private debt. Still, Japan's aggregate debt is the highest amongst the industrial world and has risen over the past decade. Aggregate debt has reached 450% of GDP.

What caused the breakdown of aggregate debt stability?

The breakdown of the stability of industrial country aggregate debt-to-income ratio remains a major puzzle to economists. Several explanations are possible. One is that the private sector behaviour is non-Ricardian. An important proponent of this view is the fiscal theory of inflation, where positive wealth effect of government debt is central to the causation of inflation (see Cochrane (2011), Sims (2011) and Leeper and Walker (2011)). To the extent that households view government and corporate debt as net wealth, they increase their borrowing to finance a higher level of consumption.

Nevertheless, tests concerning the Ricardian equivalence have been very inconclusive. The fact is that estimates of long-run private sector response to budget deficits, based either on consumption or saving, vary widely across studies.[3] A recent study by Rohn (2010) reported an average short-and long-run response of 0.4 for OECD countries, with the coefficient for the United States being as low as 0.3. The study concluded that, overall, there is no significant support for the strict version of the Ricardian equivalence.[4]

A second explanation for the breakdown of aggregate debt stability is the development of credit markets. Ben Friedman (1982) discusses the great stability of the US non-financial debt in terms of what he calls the "capital leverage hypothesis". According to this hypothesis, people have a target wealth-to-income ratio as well as a strong preference for different types of assets in their portfolio. In this model, the private sector's holdings of tangible assets (plants, machineries, real estate etc), which depends negatively on the outstanding government debt, constitute the collateral pool against which it could borrow from banks. When credit constraints are binding, a rise in government debt reduces tangible asset holdings, causing a fall in credit supply to the private sector. According to this view, financial

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[3] For instance, the estimated offset coefficients (the extent to which private saving replaces government dissaving) for OECD countries vary from 0.34 in Loayza et al (2000) to 0.7 in de Serres and Pelgrin (2003) to 0.9 in de Mello et al (2004).

[4] A clear limitation of the tests based on private saving is that they ignore balance sheet effects, which have major implications for consumption and borrowing decisions. Because capital gains on assets are excluded from the national account definition of income, the estimated response coefficients tend to be biased upward (de Mello et al (2004)). Since higher equity and house prices boost wealth, they encourage households to incur more debt. This positive wealth effect may overwhelm the negative wealth effect of higher government debt. De Mello et al (2004) show that non-inclusion of capital gains in models lead to spurious negative correlation between public and private saving. This is because while realised capital gains are not regarded as income, they are a part of the tax base for the government, which boosts government saving.

innovation and liberalisation are expected to weaken the negative link between public and private debt.[5]

A third – and perhaps more plausible explanation – has been the progressive cheapening of debt finance. Higher indebtedness has been made possible by very low real long-term interest rates. Since 2002, the real long-term interest rate on global risk-free assets – as measured by US index-linked Treasuries – has been low (see Graph 3). Over the period 1986 to 2000, the average of this long-term rate was 4¼%, and ranged between 3% and 5½%. It has also been volatile in the decade since then; but the trend has been clearly down. That this decline persisted in both the expansion and the contraction phases of the unusually sharp global cycle (and with very different fiscal positions) suggests something fundamental. By late-August 2011, it had fallen to virtually zero and sometimes below that. Real yields on UK inflation-indexed paper have been below 1% since 2009.

Economists have long debated the "normal" long-term interest rate. In his famous article, Hicks (1958) found that the yield on consols over 200 years had, in normal peacetime, been in the 3 to 3½% range. After examining the yield on consols from 1750 to 2006, Mills and Wood (2009) noted the remarkable stability of the real long-term interest rate in the UK – at about 2.9%. (The only exception was between 1915 and 1964, when it was about one percent lower). Amato's (2005) estimate was that the long-run natural interest rate in the US was around 3% over the period 1965 to 2001 and that it varied between about 2½% and 3½%.

Because the recent phenomenon of very low real long-term interest rate – well outside the range seen in earlier decades – predates the crisis, it cannot be explained by the post-crisis recession. The many structural explanations for it include: a sharp rise in saving in emerging Asian economies; the preference of central banks from high-saving countries and other official investors/managing huge stocks of foreign assets; accounting rules requiring pension funds and others to value their future liabilities by using a long-term interest rate as the

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[5] Nevertheless, the exact role of government debt in imperfect credit markets remains controversial. Under assumptions of variable wealth-to-income ratio and portfolio composition, government debt could have very different impact from that postulated by the capital leverage hypothesis. Because government bonds are high-quality collaterals, they might help in relaxing private sector credit constraint, leading to higher levels of private investment and debt. Woodford (1990) discusses two channels through which this could happen. First, higher government debt (through the exchange of liquid assets for claims on illiquid future income) would enhance investment opportunities in the economy. Second, a larger stock of liquid assets associated with higher government debt increases individuals' flexibility to respond to adverse shocks, improving efficiency and growth.

discount factor; and new regulations leading insurance companies and banks to increase their holdings of government bonds.[6]

It would be implausible to attribute to monetary policy as conventionally understood a prolonged period of low real long-term rates. Statistically, the long-term rate is not closely correlated with the contemporaneous short-term policy rate.[7] Time series of the short-term rate and the long-term rate have been shown to have quite different statistical properties. While there is of course some correlation between the two interest rates, it is unlikely to be constant over time simply because expectations shift and investors' assessment of term risk change with circumstances. There have been many periods when there has been no apparent relationship. Recall one well-known instance: during the first 18 months of the pre-crisis period of monetary policy tightening (ie from mid-2004 to end-2005) the US government bond yield did not rise – the famous Greenspan conundrum.[8]

But a monetary policy strategy that consists of giving firm guidance about the future short-term rate (we would regard this as "unconventional" – hence the underlining in the paragraph above) will exert a greater influence on long-term interest rates. Central banks now find themselves in this unconventional predicament: policy rates have been very low for three years and the Federal Reserve has declared that it expects to keep rates low until mid-2013.

The drop in real long-term interest rates has dominated the rise in debt levels. Whatever the reason, lower rates do make leveraged positions easier to finance. Lower long-term interest rates also boost asset prices – so that the asset/liability balances of debtors look better, too.

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6 These issues are discussed in Turner (2011b). See also Milne (2011).

7 The role of overly easy monetary policy in driving down long-term rates, inflating asset prices and causing the financial crisis has been much debated. Shigehara and Atkinson (2011) provide a good review of this question and analyse how far the major international institutions argued for global monetary tightening during the years before the crisis. They also argue that a central bank that encourages the market to believe that the policy rate will be kept low for years could increase leverage in the financial system.

8 There was a more subtle link between monetary policy ease and the long-term rate on this occasion. The "measured pace" policy of Federal Reserve tightening deliberately nurtured in markets a sense of interest rate predictability, which made banks and others more willing to assume large maturity mismatches – and so keep long-term rates low.

2. Fiscal policy and debt

What will determine the path of aggregate debt path in future? Following the recent crisis, households and firms may desire to deleverage and return to healthier balance sheets. Another moderating influence on debt levels could come from tighter credit and regulatory standards, which make it more difficult for some private sector borrowers to access credit than in the past.[9] The role of fiscal policy is therefore likely to rise in determining future debt levels. This raises two important questions. First, how far is fiscal policy in industrial countries conducted so as to stabilise public debt? Second, what would be the consequences of a possible sharp rise in interest rates?

Does government primary surplus rise in response to higher debt?

Central to the issue of fiscal sustainability is whether a government systematically increases its primary surplus in response to rising debt levels. It is of course difficult to determine government's fiscal stance without considering the business cycle. In addition, governments may have an explicit objective to smooth tax rates over cycles, so as to reduce their negative growth effects. Barro's ((1979) and (1986)) tax-smoothing model provides a useful framework to examine the historical fiscal behaviour of governments. In this model, government's primary balance depends on two key variables:

- The first is the level of "normal" government expenditure (excluding interest payment), which is a constant fraction of potential output. If the government's objective is to maintain an average tax rate equal to the ratio of normal spending to potential output, then its budget balance is likely to deteriorate during downswings and improve during upswings. The revenue loss during a recession is therefore proportional to the fall in output, multiplied by the normal government spending.

- The second is temporary government spending (eg abnormally high military spending during wars). The rationale is that the government avoids exceptionally high tax rates during a recession, allowing its deficit and debt to rise by the full amount of temporary spending.

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9 Nevertheless, past experience suggests that any deleveraging is likely to be gradual and protracted. Examining 15 major crisis episodes in the post WWII period, Reinhardt and Reinhardt (2010) find that a typical deleveraging cycle lasts about 7 years while the ratio of domestic credit to GDP falls, on average, by about 38 percentage points.

Using the following notation:

y = GDP

$\overset{*}{y}$ = Potential GDP

$y_t / y_{t-1} = \eta$ = Growth rate of GDP

$\overset{*}{g}$ = Normal government spending as % of GDP

g = Government spending as % of GDP. Hence $(g - \overset{*}{g})$ = $g\,\mathrm{var}$ = temporary government spending as % of GDP

$y\,\mathrm{var}$ = Cyclical influence on the primary balance, that is $(1 - y / \overset{*}{y}).(\overset{*}{g} / y)$

s = Primary balance as % of GDP

d = Debt as % of GDP

i = Interest rate

The government's fiscal response is given by:

$$s_t = \alpha_0 + \alpha_1 . y\,\mathrm{var}_t + \alpha_2 . g\,\mathrm{var}_t + \alpha_3 . d_t + \varepsilon_t \quad ..... \quad (1)$$

Bohn (1998) estimated equation (1) for the United States using $y\,\mathrm{var}$ and $g\,\mathrm{var}$ reported by Barro (1986) and Sahasakul (1984). His estimates suggested that the debt coefficient was remarkably stable up to 1995, at around 0.03 to 0.05. Using the estimated coefficient of 0.054 for 1916-1995, an average real interest rate on US government debt of 0.1% and growth rate of 3.3%, Bohn showed that the US debt-to-GDP ratio was stationary, implying that it tended to revert to its mean over time.[10]

We estimated equation (1) for the United States and the United Kingdom using annual data since 1970, but backdating the debt variable by one period to allow for the fact that governments respond to actual rather than expected debt levels at the end of the year. We also include lagged primary balance as an additional explanatory variable to see if there is significant degree of persistence in fiscal behaviour. The estimating equation is therefore:

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[10] Combining equation (1), the budget identity $d_t = x_t .(d_{t-1} - s_t)$ where $x_t = ((1 + i_t).(y_{t-1} / y_t)) \approx 1 + i_t - \eta_t$ and $\Delta d_t = d_t - d_{t-1}$ and assuming stationarity of $y\,\mathrm{var}, g\,\mathrm{var}, x\ and\ \varepsilon$, the debt-to-GDP ratio is stationary if $\bar{x}(1 - \alpha_3) \prec 1$ (Bhon, 1998).

$$s_t = \alpha_0 + \alpha_1 . y\,\mathrm{var}_t + \alpha_2 . g\,\mathrm{var}_t + \alpha_3 . d_{t-1} + \alpha_4 . s_{t-1} \ldots\ldots(2)$$

The regressions were carried out with or without the latest recession (2008–10). In another specification, we modify equation (2) by adding the real long- term interest rate as an explanatory variable. Prolonged periods of low interest rate could strengthen budget balance by boosting economic activity and reducing the need for an expansionary fiscal policy. But low interest rates could also encourage fiscal complacency, leading to a deterioration rather than improvement in primary balance. In a final specification, we explore potential non-linearity and threshold points for fiscal response to debt.

The results of the regressions are shown in Tables 1 and 2. The influence of business cycle on primary balance is captured by the unemployment gap (actual unemployment rate minus the OECD-estimated natural rate of unemployment), and normal government spending is represented by its average value relative to output for the entire sample period. The real long-term interest rate is calculated by subtracting inflation from the nominal yields on 10-year Treasury bond. As Tables 1 and 2 suggest, the regression fits the data very well in both countries, with adjusted-R squares between 0.8 and 0.9. The initial regressions showed significant autocorrelation problems, which were corrected by including the second order moving average error term in the model.[11]

As should be expected under sticky tax and expenditure policies, there is evidence of some degree of persistence of fiscal shocks in both countries. In the United Kingdom, one-fifth of any rise in primary deficit in a given year is carried over to the following years. Although the relevant coefficient in the United States is somewhat lower (0.167), it is nevertheless significant.

As predicted by the tax-smoothing model, the variable $g\,\mathrm{var}$ is negative and highly significant in all models. This reinforces Bohn's (1998) argument that excluding temporary government spending from fiscal response regressions tends to underestimate the coefficient of debt. Taken at its face value, about three-fifths of any temporary increase in US government spending is reflected in the US primary balance in the same year, with the ultimate impact rising to 72% (Table 3). The long-term impact is somewhat higher in the United Kingdom (85%) than in the United States. The cyclical variable, $y\,\mathrm{var}$, is also negative, although only in the case of United States. It is puzzling that for the United

[11] The process involves using lagged values of the forecast error to improve current forecasts. A second order moving average term uses the forecast error from two most recent periods (see Box and Jenkins (1976)).

Kingdom the coefficient of $y\text{var}$ is positive (though very small) in the regressions, suggesting some sort of pro-cyclical fiscal response.

The variable that is of most interest to us is debt. Indeed, as shown by the first two columns of Tables 1 to 2, the debt coefficients are positive and significant at 1 percent level.[12] In the United States, a 10 percentage point rise in debt-to-GDP ratio leads to 0.61 percentage point rise in the primary balance in the next year and 0.73 in total over the long run. The magnitude of this response is close to that reported by Bohn (1998) for his full sample. Interestingly, the degree of fiscal response to debt in the United Kingdom is close to that of the United States.[13]

In the United States, given the average real effective government borrowing rate of 2.41% and the growth rate of 2.83% over the period 1970 and 2010, historically the debt-to-GDP ratio remained well-contained. The fact that the estimated fiscal response to debt was also positive suggests that the debt to GDP ratio tended to revert to its mean. In the United Kingdom, the same stability condition is satisfied by a positive fiscal response coefficient in conjunction with the average real borrowing rate of 1.65% and the average growth rate of 2.10%.

Turning to the role of interest rate, we found a statistically significant positive impact only in the case of the United States (column 3 in Table 1). The results suggest that a one percentage point increase in real US bond yields leads to an improvement in the US primary balance of 0.15 percentage points in the same year and 0.18 points in the long run. In the case of the United Kingdom, however, the interest rate does not seem to matter for the fiscal stance of the government.

Our tests for potential non-linear fiscal policy response or debt thresholds did not produce meaningful results. We included a squared debt term to check whether the fiscal policy response to increases in debt levels is non-linear. The relevant coefficients, shown in column 4 of Tables 1 and 2, are close to zero in the United States and surprisingly negative in the United Kingdom. Tests for potential debt thresholds for fiscal authorities' response did not yield definitive results. As columns 5 to 7 show, none of the threshold variables (debt-to-GDP ratio exceeding 50%, 60% and 70%) is statistically significant in the regression.

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[12] In addition, the coefficients seem pretty stable; they increased modestly when we dropped the latest crisis-affected observations (2008–10) from the regression.

[13] See Gali and Perotti (2003) who reported similar fiscal response coefficients for the euro area countries (0.05) using 1980-2002.

Our results illustrate two main aspects of the UK and the US fiscal stance. First, temporary government spending does have a large effect on budget balance. Second, the average historical response of fiscal authorities to debt levels is to increase the primary surplus as a percentage of GDP.

Interest rates and public debt: what could be in store?

A key question is whether the historical fiscal response would be sufficient to stabilise debt/GDP ratios if interest rates were to rise in future. Fiscal policy in the advanced countries is already facing a crisis. First, reversing the abnormal rise in spending will strain the political budgetary process. Second, a longer-than-expected recession could lower potential output as labour skills are lost because of prolonged unemployment and the rate of capital formation is reduced.

According to the OECD (2011) projections, the US economy is likely to grow at 3.1% over the period 2012–15; but thereafter growth will converge to a lower average potential rate of 2.2%. The United Kingdom's prospects are worse than those of the United States: output is projected to rise by 2.2% in 2012-2015 and 1.9% in the following 10 years. Governments cannot count on future strong growth to resolve their debt problems.

Finally, the ageing of the population will aggravate adverse fiscal trends. At unchanged tax rates, the latest Congressional Budget Office (CBO, 2009) projection is that US government health and pension expenditures will rise by 2.8 percentage points of GDP between 2011 and 2025. UK's age-related spending is estimated by the European Commission (EC, 2009) to rise, albeit modestly, by 1.4 percentage points.

We projected the future path of debt up to 2025 under different assumptions of interest rates but constant long-term growth. One crucial variable for our projection is government's future primary balance. Rather than using equation (2) as our projecting framework, which will necessitate making assumptions about future unemployment gaps and temporary government expenditure, we follow an eclectic approach whereby primary balance is determined by exogenous and endogenous components. Following Cecchetti, Mohanty and Zampolli (2011a), the predetermined component of primary balance is given by the projected path of age-related spending and a non-age related primary balance, which is kept constant at its 2012 value as a percent of GDP. To this, we add the estimated fiscal response to debt and the persistence coefficient from equation (2) to determine the evolution of future primary balance. In notations, equations (3) to (5) provide the precise framework for projecting debt to GDP ratio.

$$d_t - d_{t-1} = \hat{r}_t d_{t-1} + s_t \quad \ldots\ldots (3)$$

$$\hat{r}_t \equiv \frac{1+i_t}{(1+\eta_t)} - 1 \cong i_t - \eta_t \quad ..... (4)$$

$$s_t = s_{2012}{}^{non-age} + s_t{}^{age} + \alpha_3\, d_{t-1} + a_4\, s_{t-1} \; ....(5)$$

Where, t subscript refers to time period, $\hat{r}$ is the difference between the interest rate and I growth rate, $s^{non-age}$ is non-age related primary deficit (e.g. revenue minus non-age, non-interest expenditure) as a percentage of GDP in 2012 (as projected by the OECD) and s^{age} is age-related spending as percentage of GDP. The coefficients α_3 and α_4 are taken from equation (2).

Graphs 4 and 5 provide projections of public debt and interest payments relative to GDP in the United States and the United Kingdom. The values for growth rates and non-age primary balance are taken from OECD, while age-related spending from the CBO (2009) and EC (2009), respectively, for the United States and the United Kingdom. Scenario I (the red dotted lines in Graphs 4 and 5) is the baseline where the government effective borrowing rate (average rate paid on outstanding debt) is raised permanently by 1 percentage point from its level projected by the OECD for 2012. This will imply that the US government finances its deficits and rolls over its existing debt at a real interest rate of 3.1% with effect from 2013 compared to 2.1% in 2012 (projected by the OECD) and 0.7% in 2011.[14] Correspondingly, UK's real borrowing rate rises to 2.6% for 2013 onward from 1.6% in 2012 and –0.5% in 2011. Under this scenario, the interest rate minus the growth rate remains positive during the projection period.

Scenarios II (green line) and III (blue line) consider interest rate shocks of 3 and 5 percentage points respectively. Such shocks could arise from a sharp rise in the short-term rate following a surprise rise in inflation or from a sudden jump in risk premia on government debt. Another source of the shock could be portfolio rebalancing by foreign investors, who might permanently reduce their exposure to the US and the UK government bonds. These scenarios illustrate the magnitude of fiscal problems that governments would face under stressed market conditions.

Under the baseline scenario, UK public debt and interest payment to GDP ratio stabilises at around the current level, implying that there is no net increase in its debt. Interest payment as a percentage of GDP rises initially because of the jump in the interest rate, but it stabilises

[14] Note that this increase is on the effective rate, which is the average interest rate paid by the government on its outstanding debt, although, in practice, the average rate is also a function of the average maturity of debt.

at its new level in subsequent years. Still, UK debt levels would continue to remain high throughout the projection period. By contrast, US public debt picks up gradually through the next decade to exceed 130% of GDP by 2025.[15] Interest payments rise steadily, but slowly, to reach 6% of GDP. Under scenario II, which is still a modest interest rate shock, the US and UK debt ratios rise, heading towards 160% and 120%, respectively. The interest-payment-to-GDP ratio increases significantly in both economies, compared to the baseline case. A 5 percentage point rise in the interest rate would lead to a much sharper rise in debt and interest payment, setting off an adverse debt dynamics. What these projections show is that, without a major change in fiscal policy, the public debt situation would worsen significantly with higher interest rates.

3. Uncertainty about future interest rates

As the discussion in the previous two sections showed, not only has aggregate debt in industrial countries risen sharply but the trend could also be aggravated by a rapid rise in public debt in future. Given this difficult outlook, it is paradoxical that the real long-term interest rate is so low.

The microeconomic paradox is that the secular decline in the real rate of interest has occurred even though the volatility of long-term rates has actually risen. This is puzzling: investors would normally require some compensation – that is, a higher yield – for holding a more volatile asset. The increase in the variability of long-term interest rate changes that Mark Watson noted in 1999 has thus persisted (Table 3). He took as the basis of his comparison the period 1965 to September 1978. As might be expected, the standard deviation of interest rate changes over that period fell along the maturity curve – from 0.44 for the Federal funds rate to 0.19 for the 10-year yield. But in recent periods this difference has vanished: the variability of short rates has actually fallen but that of long rates has risen. The standard deviation of monthly changes in 10-year yields was 24 basis points over the period from 1999 to date.

The fact that central banks have held short-term rates close to zero for a prolonged period, and are expected to continue doing so in the foreseeable future, has doubtless accentuated the decline in the long-term real interest rate. With yield curves (generally) upward sloping, and options to limit interest rate risk rather cheap, “interest rate carry” trades in many guises

[15] Our baseline debt projections are close to those reported by Gagnon (2011).

have been encouraged. It is a reasonable bet that interest rate exposures in the banking system have risen.

When sovereign debts are so large and fiscal prospects very uncertain, the risk of large movements in bond prices is surely greater than when fiscal positions are stronger. There is a huge uncertainty about future budget deficits and their financing. Economists disagree about how quickly deficits should be reduced: some would stress deflation risks and others inflation risks. The projections outlined in Section 2 indicate that government debt/GDP ratios in major countries will either remain high or continue to rise over the next few years, even assuming a modest rise in the interest rate. In the absence of policy action, debt/GDP ratios will rise further in subsequent years.

There is no consensus among economists on the impact of high government debt/GDP ratios on the level of long-term interest rates.[16] At least four dimensions are relevant.

- Macroeconomic tail risks. The credibility of fiscal and monetary policy frameworks in the advanced countries has been weakened by the crisis. And governments' ability to implement effective countercyclical fiscal policies is more constrained when debt is high. Default risks have risen.
- Ricardian versus non-Ricardian perspectives on the private sector response. In a purely Ricardian world, high government debt would have no effect on the long-term rate of interest as the private sector would increase savings to meet future tax liabilities. How Ricardian households would be in the face of a global fiscal crisis is not known.
- Nature of the policy response. The popular characterisation of this as "fiscal dominance" versus "monetary dominance" has excited much debate. As Woodford (2000) and others have shown, however, the problem is more complex. Even faithful adherence by the central bank to an anti-inflation monetary rule may not by itself be sufficient to ensure price stability – because government policy frameworks may engender fiscal expectations that are inconsistent with stable prices. Davig, Leeper and Walker (2011) argue that inflation expectations could drift up depending on the probability households attach to the government hitting its fiscal limits (the point at which government is unwilling to raise taxes to finance debt service payments).

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[16] The discussion in this section focuses on local currency debt. In the case of foreign currency debt, however, the markets enforce much lower debt/GDP ratios. Nor does this section explore the relative importance of the international versus domestic determinants of long-term yields.

- Market dynamics. How the impact of high government debt on the equilibrium long-term interest rate will translate into actual bond market movements will depend on initial market positions. The more interest rate exposures are leveraged – so that investors can be forced by sharp market movements to unwind positions in order to avoid bankruptcy – the higher the probability of destabilising dynamics once expectations change. The increased volatility of prices (historic or implied from options prices) would itself raise the measure of market risk used by banks. Such mutually reinforcing feedbacks could destabilise government bond market markets even in the absence of a new macroeconomic shock.

For all these reasons, it seems likely that a long period of high government debt/GDP ratios will increase uncertainty about the future path of interest rates, both real and nominal. Such uncertainty about the path of future interest rates (and differences in investor preferences) will make debt of different maturities imperfect substitutes. [17] Because of this, changes in the mix of short-term and long-term bonds offered by the government will change relative prices and thus influence the shape of the yield curve. At the same time, monetary policy based on setting the policy rate becomes less effective: the lower the degree of asset substitutability, the weaker the transmission of changes in the overnight rate to other interest rates. Hence government debt management policies (or central bank purchases of bonds) become more effective exactly when classic monetary policy reliant on the overnight rate works less well.

4. The long-term rate as a monetary policy variable?

Recent central bank operations in government debt markets have in effect made the long-term interest rate a policy variable. This is usually presented as wholly exceptionally – justified because of the zero lower bound (ZLB) constraint on further monetary easing once the policy rate is close to zero. The argument is that policies that shorten the maturity of debt held by the public (ie selling Treasury bills and buying government bonds) may lower long term yields without raising short-term yields, which are glued close to zero at the ZLB.

Yet the case for central bank purchases or sales of government debt rests on the more fundamental issue of imperfect asset substitutability across the yield curve. As argued above, it is uncertainty about the path of future interest rates that makes debt of different maturities imperfect substitutes. The general argument that central banks could be more effective by

[17] In a world of perfect certainty about future short-term rates, the maturity mix of debt would have no consequences because debt of different terms would be perfect substitutes for one another.

acting directly in bond markets is a very old one.[18] Open market operations in long-term government debt were central to Keynes's (1930) analysis in *Treatise on Money* of how central banks could combat slumps. Keynes argued for "open market operations [in long-term securities] to the point of saturation". He felt that central banks had "always been too nervous hitherto" about such policies, perhaps because under the "influence of crude versions of the quantity theory [of money]." He repeated this analysis in *The General Theory*:

"The monetary authority often tends in practice to concentrate upon short-term debts and to leave the price of long-term debts to be influenced by belated and imperfect reactions from the price of short-term debts – though … there is no reason why they need do so."

His advice in the 1930s for aggressive central bank purchases of bonds (or the equivalent change in Treasury issuance) went unheeded, and government debt remained overwhelmingly long-term. This limited the effectiveness of the cheap money policy instituted once Britain had left the gold standard: debt management policy ran counter to the monetary policy intent of low short-term rates (Howson, 1975).

In the closing months of World War II, with the United Kingdom facing huge government debts, Keynes reiterated his view that governments should not "fetter themselves … to a counter-liquidity preference" but should accommodate the preferences of the public for different maturities. This time he won the argument: the policy became one of an elastic supply of 10-year bonds at 2%.

Against strong Treasury and Bank of England opposition, the Radcliffe Report in 1959 reiterated Keynes's view that monetary policy should consciously influence the long-term rate of interest. It was supported by many of the economists who gave evidence to Radcliffe (Harry Johnson, R F Kahn, James Meade among them). One of the five main points of this Report was that government debt management must play a central role in monetary policy:

> "… monetary policy … can … influence the structure of interest rates through the management of the National Debt … It is not open to the monetary authorities to be neutral in their handling of this task. They must have and must consciously exercise a positive policy about interest rates, long as well as short."

It was Tobin (1963) who developed the theoretical models of how central bank operations in long-term debt markets work. He stressed the importance of the policies of government debt finance – for the long-term rate of interest. Central banks in effect issue the shortest duration official debt in their operations to implement monetary policy. From the perspective of portfolio choice, government issuance of short-term debt is like monetary expansion:

[18] The following paragraphs summarise a review set out more fully in Turner (2011a), pp 18–29.

> "There is no neat way to distinguish monetary policy from debt management, [both] the Federal Reserve and the Treasury … are engaged in debt management in the broadest sense, and both have powers to influence the whole spectrum of debt."

Milton Friedman had made exactly the same point in 1959: he devoted the third chapter of his *A program for monetary stability*. (They disagreed, however, on policy implications.)

Tobin went on to argue for the use of debt management (ie shifting between short-dated and long-dated paper) as a countercyclical policy to influence private capital formation, and thus real output. His conclusion was that:

> "The Federal Reserve cannot make rational decisions of monetary policy without knowing what kind of debt the Treasury intends to issue. The Treasury cannot rationally determine the maturity structure of the interest-bearing debt without knowing how much debt the Federal Reserve intends to monetise".

His analysis was that of portfolio choice under uncertainty (which he had used in his famous interpretation of Keynes's liquidity preference theory). Nobody disputes the logic or importance of such portfolio rebalancing effects. But there is much controversy about magnitudes. This is probably because the degree of substitutability across asset classes is not stable but rather depends on macroeconomic and financial conditions. This makes empirical estimation of cross-asset elasticities of substitution very hard.

5. The macroeconomic policy framework for government debt management

Imperfect substitutability between assets of different maturities means that government debt management choices matter for the long-term interest rate. In principle, government debt management decisions could be made independently of macroeconomic or monetary developments. But, in practice, they are probably not.

(i) Macroeconomic responses of government debt managers

The average maturity of issuance of US government debt has shown significant variation over the years. For much of the period from the 1950s to the 1970s, the US Treasury relied heavily on short-term debt. The post-war minimum in average maturity was just 28 months (in January 1976). From the second half of the 1970s, however, the US Treasury adopted a deliberate policy of lengthening their debt (Graph 6). The issuance of the 30-year bond contributed significantly to lengthening maturities during the 1980s (save for the period after the 1987 equity market collapse). By the early 1990s, however, the US government was again arguing that shortening the maturity of debt would produce significant savings on interest costs. But the most notable phases of debt maturity shortening were from late 1993 to 1996 (the bond market crisis of early 1994 cast a long shadow) and between 2000 and 2004 (when monetary policy also turned more accommodative). In October 2001, the US Treasury announced it would no longer issue the 30-year bond. The average maturity of Federal government debt was steadily reduced to under 5 years by 2004. But the issuance of 30-year bonds was revived in 2005. And in recent years, the policy objective has been to lengthen the (still comparatively short) maturity of US government debts.

Have these swings in the average maturity of debt over the past 30 years been related to macroeconomic policies? As there does not seem to be much empirical analysis of this question,[19] we tried a naïve regression of the year-to-year change in the average maturity of bonds outstanding in months on two simple policy variables: the Federal funds rate and the Federal deficit/GDP ratio. The regression was run on annual data over the period 1982 to 2010. The Federal deficit as a percentage of GDP, which is not known immediately, is lagged one year (equation (a) in Table 4). In a second specification, we replaced the Federal funds rate with the difference between 10-year and federal funds rate to see if average maturity is sensitive to a measure of spread. In a final specification we replaced the deficit/GDP with outstanding debt.

All variables are statistically significant. The simplicity of the regression for equation (a) came as a surprise. This equation provides prima facie evidence that the maturity of outstanding debt is usually shortened when the Federal funds rate is low. This suggests that debt managers deliberately take advantage of unusually low near-term market rates to shorten the maturity of issuance when the central bank's policy stance is accommodating. In this sense, debt issuance and monetary policy work in the same direction. The sign on the fiscal variable suggests that a larger fiscal deficit tends to be associated with a lengthening in maturities. Debt managers often say that longer maturities are indeed needed to spread out over longer time periods the higher debt created by fiscal deficits.

The robustness of this finding is confirmed by the results of two other regressions. Using the yield spread, instead of policy rate, does not change the message: the higher the spread the lower is the average debt maturity (equation (b) on Table 4) . The coefficient of spread is about the same size as the Federal funds rate, but, of course, with a negative sign. In addition, the deficit coefficient remained largely unaltered. Using debt instead of deficit produced similar results (the coefficient of the Federal funds rate is only slightly lower than that in equation (a)).

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19 With the notable exception of Hoogduin et al (2010).

This empirical link between debt management choices and two simple measures of both fiscal policy and monetary policy suggests that debt management choices have in practice been endogenous with respect to macroeconomic policy – even if debt managers usually claim innocence of macroeconomic policy intent.

Indeed, the policy debates about the mandates of government debt managers have usually turned on microeconomic criteria such as keeping government debt markets liquid, minimising the cost of government borrowing, limiting refunding risks and so on. There is no accepted theory of macroeconomics of government debt management.

A lively debate among economists about how to frame the macroeconomic analysis of government debt management has begun.

One element of the literature is the stabilising or destabilising properties of different debt structures in the face of cyclical movements in GNP or other shocks. Fiscal insurance has been a central theme in this literature. In 1998, Barro constructed a model showing that issuing inflation-linked bonds would smooth tax rates in the face of GNP cycles. He also argued that persistent inflation shocks would make long-term nominal bonds more volatile than short-term ones. Hence the government would shift to short-term issues as the volatility of inflation rose. Missale (1999) took a similar perspective. Tax revenues rise with cyclical increases in income (real and inflation). Short-term interest rates are also procyclical. Hence short-term debt ensures tax revenue and interest payments move together.

Another version of fiscal insurance goes like this. Suppose a government is faced with a deterioration in its fiscal position: that is (according to reasoning based on an intertemporal budget constraint), a rise in future primary surpluses to pay back the debt. A fall in the market value of government debt can help maintain this intertemporal budget constraint (Cochrane, (2011)). A government could reduce the market value of its debt by driving up the long-term rate. It can do this by lengthening the maturity of its issuance.

In theory, there is no limit to the amount of long-term paper a government can issue in its own currency. At the limit, it could overfund the budget deficit – issue long-dated paper on a massive scale and buy short-term assets from the private sector. One study – cited by Faraglia et al (2010) – found that, given the flatness of the yield curve and its limited volatility, a government following such a strategy would have to hold five or six times GDP in privately issued short bonds and issue similar amounts of long bonds. It is hardly surprising this is not what happens as Faraglia et al (2008) have shown. The reason is liquidity and credit constraints. The potential private buyers of government debt face liquidity constraints which prevent them from buying an infinite amount of government bonds. The government has a credit constraint in that it would not want to hold an unlimited amount of risky private assets. The assumption of market completeness is therefore not satisfied.[20]

The lack of a well-accepted theory is supported by the absence of striking empirical facts. The size of the macroeconomic impacts of more activist debt-management policies depends on the strength of portfolio-balancing and the substitutability between short-term and long-term debts. For the reasons discussed above, such substitutability will not be uniform either across countries or over time. The experience of one country will not necessarily be a good guide to what would happen in another country. What works in one episode will not necessarily work in another. Nevertheless, it is not difficult to imagine circumstances in which such policies can be highly effective. In times of crisis, for instance, a large (but temporary) decline in asset substitutability (because of greater macroeconomic uncertainty, banks with weakened balance sheets less able to take interest rate risks etc) will make activist debt management policies more effective.

(ii) Coordination between central banks and debt managers

It is clear that activism motivated by macroeconomic objectives in both debt management policies by the Treasury (or DMO) and central bank balance sheet policies would create coordination problems. A central bank could not take optimal decisions in response to macroeconomic developments if it did not take account of how the Treasury would respond. Paul Fisher's recent report (BIS, 2011) on potential interactions between sovereign debt management and central banks provides an authoritative account of (difficult) coordination issues. His report analyses how circumstances can alter the nature of policy spillovers involved. It considers practical steps to ensure effective coordination.

How any policy towards the long-term rate is made operational would matter. A target range could be set for the long-term rate itself (as Keynes advocated): in this case, the central bank balance sheet/government debt issuance becomes endogenous. Or the authorities could set quantity targets for sales or purchases of government debt (as in the recent policies of

[20] Faraglia et al (2010) put this well: "In order to exploit the maturity structure of debt the complete market approach requires large positions. If governments were to try [this] … they would have to buy and sell enormous amounts of bonds each period. This would entail all kinds of transaction costs, refinancing risks, and it would force some private agents in the economy to hold the opposite of the huge positions the government decided to take, possibly facing credit constraints. The government would have to hold very large amounts of private debt which could be defaulted upon. The weakness with the complete market approach is it … abstracts from [these] fundamental features of market incompleteness." Note that their analysis is framed in a closed economy context. In an open economy, the government has much greater scope to influence the prices of local long-term debts because it can buy foreign assets. This is what Asian central banks are doing.

Quantitative Easing – QE) leaving the market to determine the rate. Coordination mechanisms would be different according to which mode of operation is selected.[21]

Without mechanisms to ensure the consistency of different policies, QE operations decided by the central bank could well be contradicted by Treasury financing decisions. Remember that the government's balance sheet is much larger in normal times than that of the central bank. It is true that the central bank's balance sheet is usually more elastic – because it can create liabilities on a very large scale to finance assets. But if its policies just induce the opposite reaction of the debt manager (taking advantage of an unusual configuration of interest rates), its theoretical elasticity will have less practical effect. Recall the famous "Operation Twist".[22] When the Federal Reserve used open market operations to flatten the yield curve by shortening the average maturity of Treasury debt in the early 1960s, the US Treasury in effect worked against this policy by lengthening the maturity of issuance.

What about the recent QE policies in the United Sates? QE cannot be analysed without taking account of changes in Treasury debt management policies. The US Treasury has been lengthening the average maturity of its outstanding debt in recent years. This is difficult to square with QE, which aims to shorten the maturity of bonds held by the public.[23] One simple approach is to examine elements of the consolidated balance sheet of the Treasury and the central bank. The first table in Tobin's 1963 classic paper – which summarised the structure of Federal government debt in the hands of the public – is a good place to start. (But it is, of course, a highly stylised characterisation of the monetary impulse of changes in debt maturity).[24]

With the adoption of QE after the crisis, reliance on short-term debt and Federal Reserve obligations was increased. Between the end of FY2007 and the end of FY2009, currency and Federal Reserve obligations more than doubled (Table 5). Short-term marketable securities outstanding also doubled. With an almost $2 trillion expansion in money and short-dated paper, this clearly represented a very significant easing of policy. What might be called "monetary financing" in the first two years of the crisis went from 34% to 43%.

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[21] Other matters to be decided would include the target maturity, the inclusion or not of inflation-indexed bonds etc.

[22] Chadha and Holly (2011) estimate that the Federal Reserve's purchases of $8.8 billion under this programme is the equivalent of $225 billion when scaled at today's GDP.

[23] The published minutes of the Treasury Borrowing Advisory Committee clearly explain that the different mandates of the Federal Reserve and the Treasury debt managers can conflict: see Turner (2011a) pp 43.

[24] Quite different and special issues arise in the euro area because it does not have a single fiscal authority. Hoogduin et al (2010) point out that the Maastricht Treaty did not constrain national debt managers in the euro area – even though their local decisions could have monetary implications. They show that, in the euro area, a steepening of the yield curve had led national debt managers to shorten the duration of their issuance.

But in the third year of the crisis, the maturity of Treasury debt issuance changed in a restrictive direction. Monetary financing actually declined from 43% at end-September 2009 and to 35.5% at end-September 2010. In the most recent period, QE was partly offset by longer-dated Treasury issuance.

Table 6 provides further data on maturity choices over the recent QE episode. It shows that the Federal Reserve's portfolio of US Treasuries with a maturity of two years or more rose by $759 billion; US Treasury issuance was $1303 billion. Hence Federal Reserve policies reduced the volume of new long-dated paper to be sold to the public, which tended to lower bond yields. But note, however, that Treasury issuance was of longer maturity than Federal Reserve purchases. The average maturity of new issuance placed with the public rose to 7.8 years – as the average maturity of Federal Reserve purchases was a little below that of gross Treasury issuance. It was just over four years in 2006 – the last full year before the crisis. Thus the maturity of debt issuance between 2006 and 2011 has moved in a restrictive direction on policy debates.

Conclusion

The 2007–20xx financial crisis came after very many years of rising indebtedness in the advanced economies. The *immediate* task of monetary policy in an over-indebted but low-inflation economy after a bubble has burst is simple to state: counter the downward shock to aggregate demand coming from the deleveraging of households, banks and others. Central banks have done this not only in an orthodox way (by lowering their policy rates), but also by unorthodox balance sheet policies. They bought government bonds on a massive scale to drive down the benchmark long-term rate and also purchased private assets to narrow credit-risk premia. Not only have such policies stimulated aggregate demand but they have also helped keep debtors afloat, reduced the default risks facing creditors and so avoided a cascading sequence of bankruptcies. The monetary policy blunders of the 1930s were thus avoided, and the spectre of debt deflation averted.

But central banks are always uncomfortable with such unorthodox policies. Holding growing volumes of government bonds could complicate future relations with the Treasury, and may even be seen as "monetising" government debt. Holding private assets opens the central bank to charges of preferential credit allocation. From mid-2009, therefore, they put more emphasis on how to reverse these unorthodox policies. The President of the ECB wrote in September 2009 that Europe had mapped its monetary exit (Trichet, 2009). The Chairman of the Federal Reserve testified to Congress in February 2010 about the Federal Reserve's so-called "exit strategy" (Bernanke (2010)). But a deepening crisis in the euro area in May

2010 and a sharp deterioration in economic prospects put any such exit on hold. Central banks further expanded their balance sheets, increasing their holdings of longer-dated paper. What had started as an emergency response to a severe crisis became rather lasting.

Keynes, Tobin and the authors of the Radcliffe Report would have felt vindicated by the policies followed by central banks. This paper has reiterated their view that the fundamental rationale for the active use of balance sheet policies rests on imperfect asset substitutability. The Zero Lower Bound argument (when the rate is at zero, the reasoning goes, the central bank should buy bonds in order to directly lower yields further along the maturity spectrum) can reinforce this fundamental case for balance sheet policies. But it is not essential to it.

Of key importance for central banks is that uncertainty about the path of future interest rates will make debt of different maturities imperfect substitutes. How and when the fiscal crisis facing the advanced countries is resolved will have a determining influence on such uncertainty. A long period of high government debt, and the absence of a credible fiscal strategy, could at some point lead to inflation and to higher interest rates. Or violent bond market reactions to large deficits might trigger the adoption of deflationary policies. Whatever the scenario that eventually plays out, it seems likely that a long period of high government debt will increase uncertainty about the future path of interest rates. As the scenarios outlined in this paper show, debt/GDP ratios will make fiscal positions more sensitive to changes in interest rates, and the feedbacks between monetary policy and fiscal policy become stronger.

This prospect of deeper fiscal-monetary interactions could give central banks some headaches. Heavily-indebted governments like low interest rates; but monetary policy needs will not always be served by such low rates. Two other policy questions related to fiscal-monetary linkages also require more attention. One question is whether central bank decisions on the purchase or sale of government bonds should be influenced by the central bank's assessment of the sustainability of the government's fiscal stance: buying government bonds to hold down – even temporarily – the long-term rate could weaken market pressure on governments to act quickly to lower deficits. There is evidence for the United States (but not the United Kingdom) is that higher long-term rates do encourage fiscal correction. Another policy question is the relationship between central bank balance sheet policies and government debt issuance policies. This paper has argued that such policies have sometimes been inconsistent: a clearer policy framework is needed for purchases and for eventual sales.

The longer the fiscal crisis lasts, the greater the likelihood that central banks will come under pressure from governments to avoid destabilising increases in the policy rate and to add to their holdings of Treasury debt (or at least not reduce them). One argument advanced by savvy governments could be that market uncertainty about future budget deficits would be aggravated if higher interest rates were to accentuate already fragile debt dynamics. Governments would perhaps portray themselves as the victims of financial speculators. The greater volatility of bond yields – which would itself deter buyers – could call for some stabilising market operations by the central bank. In some circumstances, such operations would be entirely justified – central banks by their recent actions have indeed validated this line of argument. But in other circumstances it would merely amount to a rationalisation of fiscal or other policy failures, undermining monetary policy frameworks and creating inflation risks. The challenge for central banks will be to discriminate correctly, and in good time, between these two cases. When markets are volatile, and when the deeper causes of such volatility lie well outside the legitimate domain of monetary policy, central banks face an almost-impossible task.

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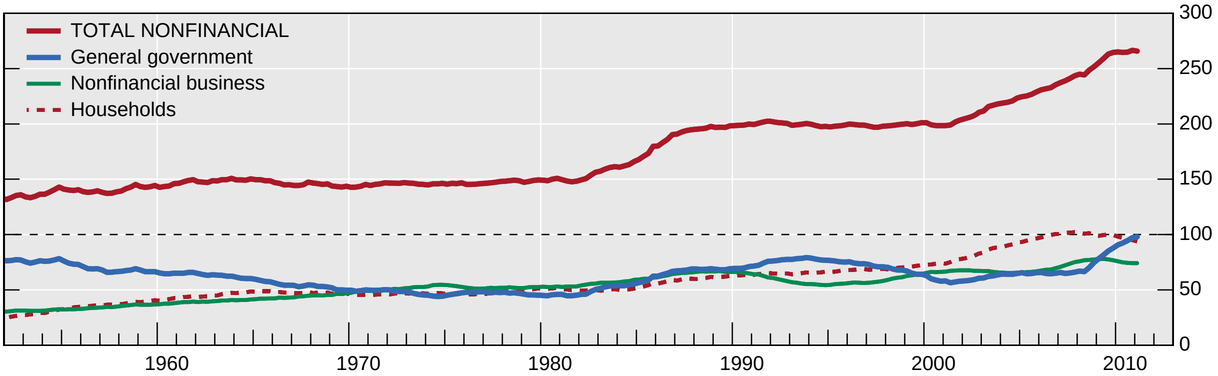
Graph 1

Outstanding debt of domestic US nonfinancial borrowers

As a percentage of GDP

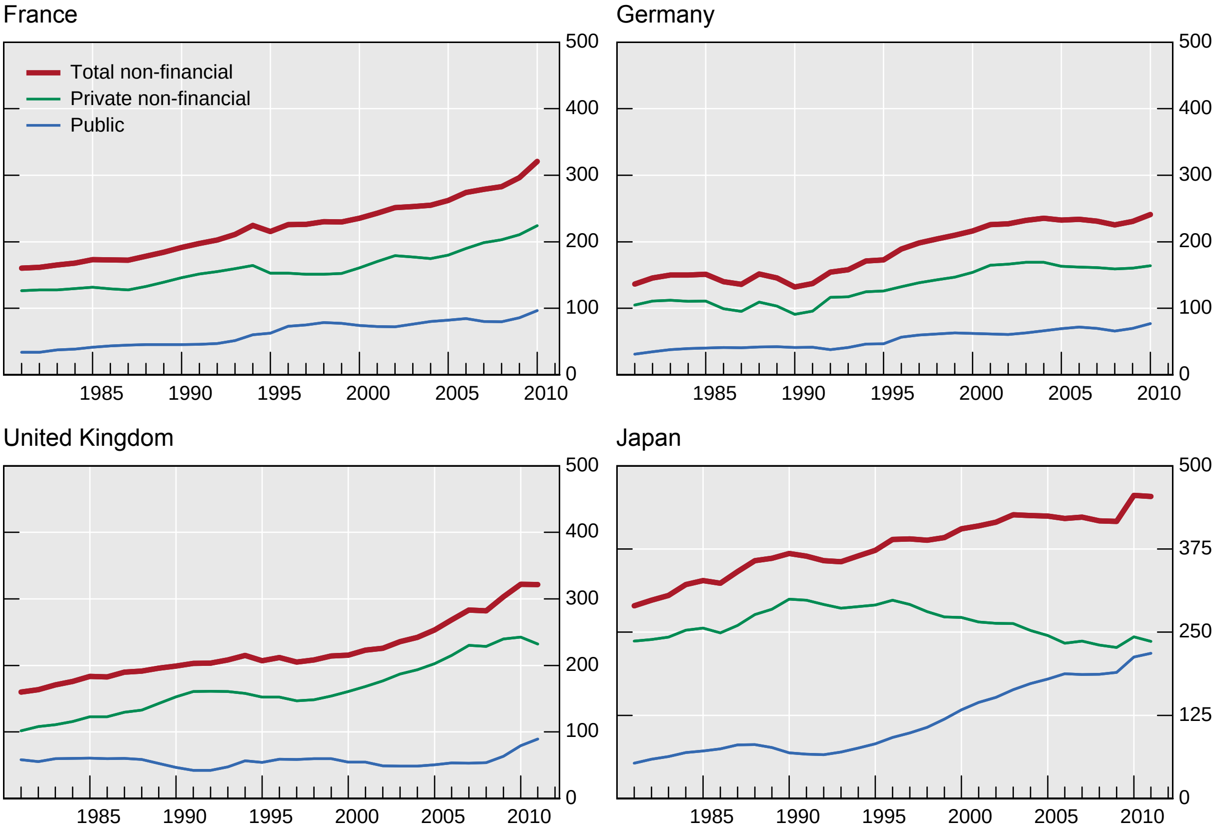


Sources: Board of Governors of the Federal Reserve.

Graph 2

Aggregate non-financial debt

As a percentage of GDP

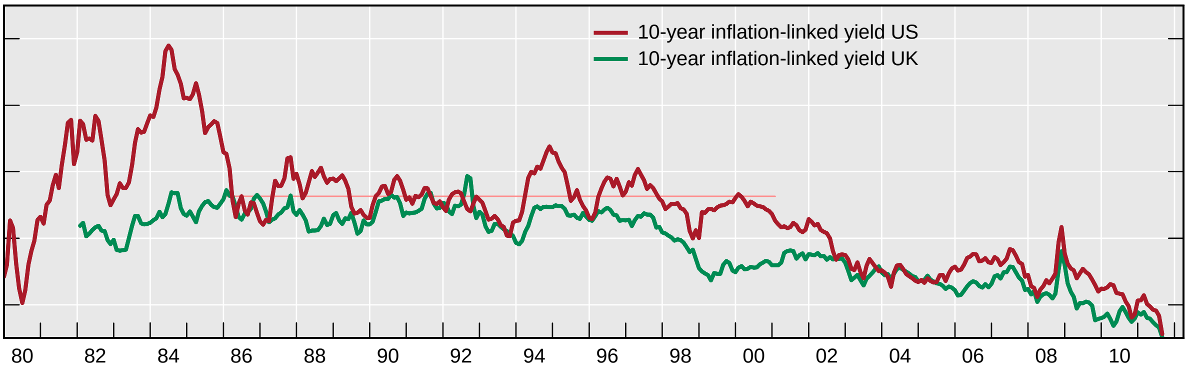


Footnote text

Graph 3

Real long-term us treasury yields

In per cent

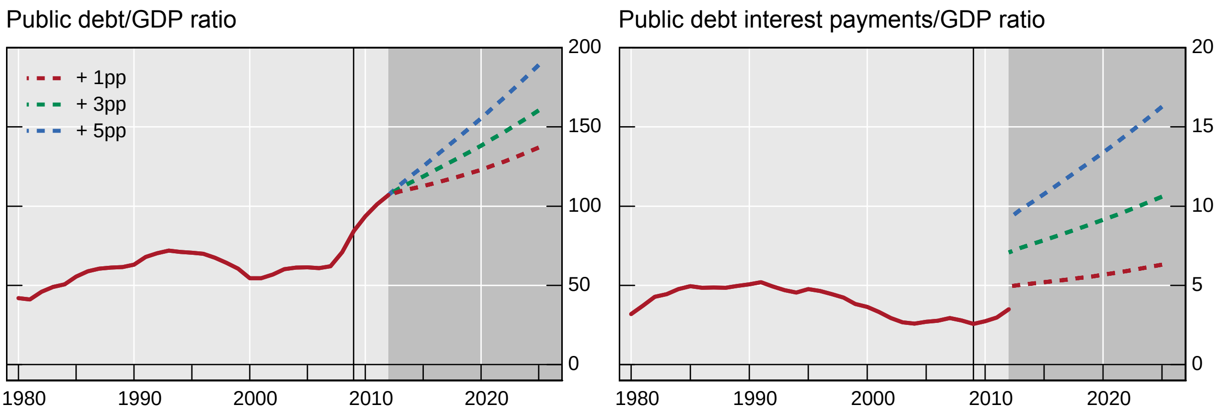


[1] Ten-year Treasury Inflation Indexed zero coupon yields (TIPS); prior to 1999, return on ten-year zero coupon bond deflated by centered three-year moving average of core PCE inflation. The horizontal line indicates the 1986–2000 average of the 10-year US inflation-linked yield (4.26%). The average of the Fed funds rate over that period was 5.82%.

Source: National data; BIS calculations.

Graph 4

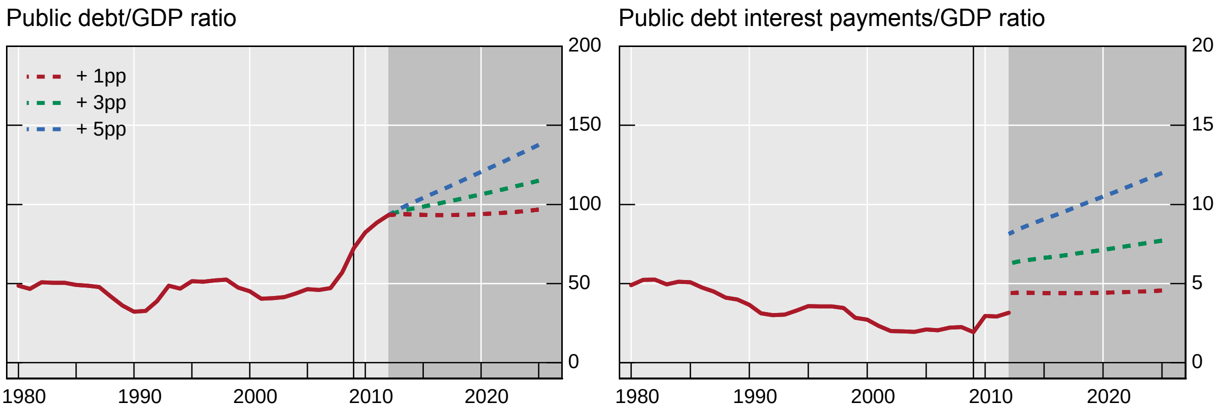
US fiscal scenarios with different interest rate assumptions



Source: Authors' calculations.

Graph 5

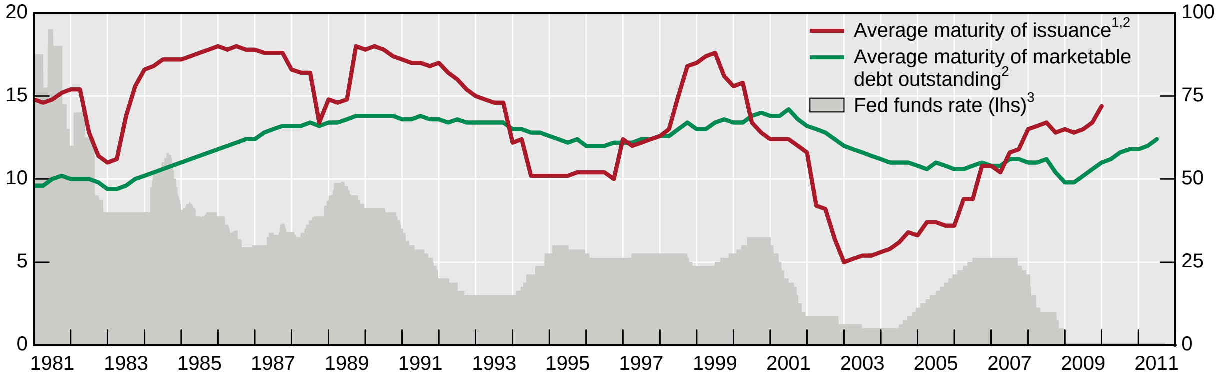
UK fiscal scenarios with different interest rate assumptions



Source: Authors' calculations.

Graph 6

Maturity of US government bonds



[1] One-year moving average; shown at the end. [2] In months. [3] In per cent.

Source: Datastream; US Treasury.

Table 1	Fiscal policy response: United States						
	1	2	3	4	5	6	7
Variables	**Baseline 1970-2010**	**Baseline 1970-2007**	**Regr (1) with interest rate**	**Non-linear effect on (1)**	**Threshold effect on (1)**		
gvar	–0.596	–0.668	–0.818	–0.486	–0.519	–0.493	–0.588
	(–5.892)	(–4.685)	(–6.687)	(–2.645)	(–1.897)	(–4.345)	(–4.629)
yvar	–0.031	–0.022	–0.021	–0.029	–0.027	–0.032	–0.033
	(–7.433)	(–3.479)	(–5.345)	(–4.625)	(–5.003)	(–7.688)	(–6.621)
d(-1)	0.061	0.083	0.071	0.068	0.202	0.081	0.045
	(3.363)	(3.308)	(3.425)	(2.364)	(1.953)	(2.982)	(2.000)
s(-1)	0.167	0.172	0.174	0.156	0.181	0.174	0.212
	(3.057)	(2.088)	(2.875)	(1.822)	(1.823)	(2.406)	(3.243)
Real Interest Rate			0.152				
			(3.395)				
Debt Squared				0.001			
				(0.880)			
Debt Threshold (> 50%)					–0.127		
					(–1.334)		
Debt Threshold (> 60%)						–0.040	
						(–1.438)	
Debt Threshold (> 70%)							0.043
							(1.162)
Constant	–2.222	–3.449	–2.693	–3.560	–9.58	–3.298	–1.342
	(–1.855)	(–2.589)	(–2.167)	(–2.522)	(–1.897)	(–2.164)	(–1.007)
Observations	41	38	40	40	40	41	41
R-squared	0.963	0.910	0.970	0.940	0.941	0.965	0.963
SE of regression	0.560	0.600	0.521	0.718	0.723	0.559	0.572
Breusch-Godfrey F-stat	0.507	0.478	0.180	2.789	3.803	0.053	0.574
- Prob. F(1,n)	(0.482)	(0.495)	(0.674)	(0.105)	(0.060)	(0.820)	(0.454)

This table reports Equation (1) given on p 9 in the text.

Notes: Dependent variable is primary balance budget/GDP (*PBD*); t-statistics in brackets; White robust standard errors for the regression 1-4, HAC robust standard errors for the regression 5-7. *Debt (d)* is general government debt/GDP; *Real interest rate* is calculated from the 10-year government bond yield; *Debt squared* is defined as $(debt_{t-1} – debt^*)^2$, where debt* is the long-term average of public debt/GDP; the D*ebt threshold* variables are computed as interactive terms with the respective dummy for each threshold value. Second order moving averages terms were employed to correct for autocorrelation. The coefficients of the dummy and MA(q) variables are not reported for brevity.

Table 2	Fiscal policy response: United Kingdom						
	1	2	3	4	5	6	7
Variables	**Baseline 1970-2010**	**Baseline 1970-2007**	**Regr (1) with interest rate**	**Non-linear effect on (1)**	**Threshold effect on (1)**		
gvar	–0.673	–0.642	–0.651	–0.441	–0.618	–0.703	–0.470
	(–4.802)	(–5.633)	(–4.716)	(–3.192)	(–3.971)	(–4.501)	(–4.563)
yvar	0.006	0.006	0.006	0.005	0.005	0.006	0.004
	(2.150)	(2.139)	(2.248)	(2.352)	(1.702)	(1.732)	(1.908)
d(-1)	0.056	0.066	0.051	0.076	0.087	0.100	0.114
	(2.026)	(2.130)	(1.653)	(4.171)	(0.975)	(2.119)	(2.734)
s(-1)	0.208	0.141	0.239	0.568	0.289	0.186	0.435
	(1.904)	(1.060)	(2.263)	(4.623)	(2.266)	(1.589)	(4.182)
Real Interest Rate			–0.079				
			(–0.601)				
Debt Squared				–0.006			
				(–4.813)			
Debt Threshold (> 50%)					–0.059		
					(–0.599)		
Debt Threshold (> 60%)						–0.103	
						(–1.805)	
Debt Threshold (> 70%)							0.0944
							(1.258)
Constant	–5.048	–5.496	–4.809	–5.270	–7.162	–7.488	–7.625
	(–3.104)	(–2.868)	(–2.779)	(–3.919)	(–1.582)	(–2.773)	(–3.222)
Observations	40	37	40	40	40	40	40
R-squared	0.808	0.784	0.810	0.822	0.822	0.825	0.874
SE of regression	1.396	1.220	1.410	1.362	1.384	1.375	1.163
Breusch-Godfrey F-stat	0.274	0.497	0.315	0.647	0.293	0.026	0.197
- Prob. F(1,n)	(0.604)	(0.486)	(0.579)	(0.427)	(0.592)	(0.872)	(0.661)

Notes: Dependent variable is primary balance budget/GDP (*PBD*); t-statistics in brackets; White robust standard errors for the regression 1-4, HAC robust standard errors for the regression 5-7. *Debt* (d) is general government debt/GDP; *Real interest rate* is calculated from the 10-year government bond yield; *Debt squared* is defined as $(debt_{t-1} - debt^*)^2$, where debt* is the long-term average of public debt/GDP; the D*ebt threshold* variables are computed as interactive terms with the respective dummy for each threshold value. Second order moving averages terms were employed to correct for autocorrelation. The coefficients of the dummy and MA(q) variables are not reported for brevity.

Table 3	Standard deviations of interest rate changes				
	Fed funds	**3-month T-bill**	**10-year nominal yield**	**10-year real yield**	**Term premium[1]**
1965.1 to 1978.9	0.45	0.37	0.19	na	0.33
1981.1 to 1998.12	0.24	0.20	0.25	0.25	0.23
1999.1 to 2011.8	0.20	0.21	0.24	0.20	0.28

[1] 10-year nominal yield less 3-month Treasury bill rate.

Note: Standard deviation of the first differences of the monthly averages of daily observations of interest rates measured in percentage points.

Table 4	**Response of average maturity to macroeconomic variables**							
	Constant term	**Fed funds**	**Deficit (-1)**	**10 years yields - Fed funds**	**Debt (-1)**	Adjusted R-squared	F-stat	DW
regr. (1)	-6.810	1.117	106.876			0.596	14.296	1.536
	(-3.150)	(4.279)	(4.684)					
regr. (2)	-0.535		101.151	-1.264		0.563	12.609	1.698
	(-0.432)		(4.096)	(-3.759)				
regr. (3)	-27.323	1.013			33.945	0.429	7.762	1.588
	(-3.138)	(3.301)			(2.986)			

Notes: Dependent variable: year-to-year changes in average maturity of outstanding public debt in the United States, in months; t-statistics in brackets. The coefficients of the first-order autoregressive term are not reported for brevity.

Table 5 **Composition of marketable US Federal government debt held by the public**

$ billion

End of fiscal year (Sept)	Marketable securities		Currency & Federal Reserve obligations	Total	Money, Federal Reserve obligations and short-term debt
	(<or = 1 year)	(> 1 year)			
	(a)	(b)	(c)	(d)	= (a+c) % d
1st 2 years of crisis					
2007	955	3474	834	5263	34%
2009	1986	5002	1780	8768	42.9%
	+1031		+946		
3rd year of crisis					
2010[1]	1784	6692	1896	10419	35.5%
	–202		+163		
Latest QE					
2011 June	1529	7785	2659	11973	35%

[1] Using Monthly Statement of the Public Debt of the United States; Federal Reserve Table H.4.1.

Sources: This is an update of that in Tobin (1963) using US Treasury Bulletin; Federal Reserve Flow-of-Funds.

Table 6 **Activity in US Treasuries**

Change from 12 November to 30 June 2010

	$ billion	Average maturity (years)
Federal Reserve's portfolio	759	6.9
Stock of Treasury debt	1303	7.2
Treasury debt *minus* Fed's holdings	544	7.8

Note: This is a summary of issuance of bonds with maturities of two-years or more.

Source: FRBNY and US Treasury.