The Economic Consequences of Rising U.S. Government Debt: Privileges at Risk

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Abstract

The rapidly growing federal government debt has become a concern for policy makers and the public. Yet the U.S. government has seemingly unbounded access to credit at low interest rates. Historically, Treasury yields have been below the growth rate of the economy. The paper examines the ramifications of debt financing at low interest rates. Given the short maturity of U.S. public debt – over $2.5 trillion maturing within a year – investor expectations are critical. Excessive debts justify reasonable doubts about solvency and monetary stability and thus undermine a financing strategy built on the perception that U.S. debt is safe.

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1. Introduction

The rapidly growing U.S. government debt has become a concern for policy makers and the public. The ratio of U.S. public debt to GDP has increased from 36.2% in 2007 to 62.2% at the end 2010. Under current policies, the debt-GDP ratio is expected to reach 80% in 2014 and 100% by 2021.[1]

What are the consequences of this rising U.S. government debt? The paper will argue that a proper analysis of U.S. debt must account for the U.S. government's ability to issue debt at interest rates that are on average below the growth rate of the U.S. economy. Evidence suggests that the low interest rates are largely due to perceptions of safety, with a secondary role for liquidity effects. Given the short maturity of U.S. public debt – over $2.5 trillion maturing within a year – investor expectations are critical. To refinance its debt, the government must ensure that bond buyers remain firmly convinced of the government's solvency. Excessive debts justify reasonable doubts about solvency and about inflation. Hence they undermine a financing strategy built on a perception of safety.

One should acknowledge at the outset that many economists have a positive view of deficit spending during a recession. Most New Keynesian models imply substantial fiscal multipliers. The multiplier effects tend to be strengthened by zero interest rates (Christiano et al. 2009) and by expectations of future fiscal stabilization (Corsetti et al. 2010). A related argument is that the U.S. economy suffers from Fisherian debt deflation that could be stopped by aggressive deficit spending (Eggertsson and Krugman 2011). Government solvency and access to refinancing are often taken for granted in this literature, which leaves the question what—if anything—may limit or discourage government debt accumulation.[2]

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[1] See the *U.S. Budget 2012* for historical values. Years refer to fiscal years (ending Sept.30), as customary in the U.S. Projections for future debt/GDP necessarily depend on assumptions about the economy, about the fate of expiring tax provisions, and about health care cost. The Congressional Budget Office (2011) provides debt/GDP projections for two scenarios, an *extended-baseline* and an *alternative fiscal scenario*, which "incorporates several changes to current law that are widely expected to occur." The changes refer to extensions of various temporary tax and spending provisions that have been renewed routinely in the past and are considered part of current policy. Under this alternative fiscal scenario, debt/GDP is projected to be 80% in 2014 and 101% in 2021. See Auerbach and Gale (2011) for further analysis of the U.S. budget outlook; their projections for debt/GDP in 2021 range from 76% to 109%.

[2] For example, Eggertsson and Krugman assume the government can impose lump-sum taxes on bondholders, so government solvency is automatic. Since multiplier effects are complex and the subject of an extensive literature, their analysis is beyond the scope of this paper.

The paper is organized as follows. Section 2 examines the government's role as financial intermediary, focusing on the "specialness" of U.S. debt, on debt limits at low interest rates, and on the ramifications of the U.S. government's safe-debt financing strategy. Section 3 turns to the problem of managing expectations, notably inflationary expectations and the potential for a confidence crisis. Section 4 comments briefly on conventional macroeconomic effects of government debt. Section 5 concludes.

2. Government as Financial Intermediary

A government that allows its citizens to defer payments for current public goods and services is in effect providing credit. If this credit to tax payers is financed by public debt, government is acting as financial intermediary. This role is well recognized in special cases, such as student loans, but applies to all public debt. This intermediation function of public debt matters even if the conventional macro effects are small. The most relevant measure is the public debt (also known as net debt or publicly-held debt). Government-held debt and other obligations, such as Social Security and Medicare, may matter indirectly as they influence the resources available to service the public debt.[3]

Government acting as intermediary raises several questions: What is the value-added, and how does it vary with debt? What are the limits? What are the risks?

2.1. Specialness

A first key question is to what extent government has an inherent cost advantage over private intermediaries, either due to superior debt-collection powers (the power of tax collectors) or because government bonds have a "special" collateral or liquidity value. The answer determines the value-added of government intermediation and it matters for the government's ability (or inability) to float unbacked debt. Specialness should be distinguished from mere safety. Safe assets—defined broadly to include nominal debt—are usually subject to the same principles of intertemporal asset pricing as risky assets; i.e., the price equals the present value of future payments (principal and interest) discounted by as stochastic discount factor (see, e.g., Duffie 1992). An asset is special if its price is greater than the

[3] Government debt has also generational implications, as it effectively allows the old to leave negative bequests. However, intergenerational transfers are a broader issue and do not require explicit debt. For this paper, it is instructive to think about government debt in banking terms. See Auerbach (2009) for further discussion of objectives for government debt.

usual present value of future payments.[4]

Specialness of debt is based on scarcity and therefore likely to erode with rising debt. Krishnamurthy and Vissing-Jorgensen (2008) document that the spread between AAA-corporate and Treasury yields varies negatively with the debt-GDP ratio.[5] As their non-linear regressions are difficult to interpret, I use essentially the same data to estimate a simple truncated linear regression. For 1925-2007 (pre-crisis), one finds

$$\underset{}{Spread_t} = \underset{(.0573\%)}{0.3111\,\%} + \underset{(.296\%)}{3.055\,\%} \cdot Max[55\% - (Debt/GDP)_t, 0]$$

with standard errors in parentheses, R^2=0.567. *Debt/GDP* is measured at the end of each fiscal year. *Spread* is the difference between AAA and long-term Treasury yields in the month after the fiscal year ended.[6] Figure 1 shows the regression line and a scatter plot.

Because even AAA corporations are not entirely default-free, the AAA-Treasury spread may reflect safety as well as specialness. The negative slope suggests that specialness matters at least at low debt-GDP ratios. One may suspect that most of the 0.31% spread for debt/GDP over 55% is risk-related. Regardless of interpretation, the spread estimates provide an upper bound on specialness. It will be important below that specialness can explain at most a small fraction the equity premium.

The declining AAA-Treasury spread documents an adverse consequence of high public debt. The fitted line in Figure 1 declines from 1.52% at 16% debt/GDP (the sample minimum) to 0.31% at 55% debt/GDP. The 2010 debt-GDP ratio of 62% is already in the flat range. Hence further increases in debt are not likely to reduce the spread—the damage to specialness is already done. However, the spread has been above normal in the crisis and post-crisis years 2008-10.

Because most taxpayers would pay interest rates higher than AAA, private benefits from government intermediation are greater than the AAA-Treasury spread. Because the government

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[4] An extreme example is fiat money, which pays no interest and hence has a zero present value of future interest payments; it is valued purely as medium of exchange.

[5] An earlier literature on specialness was motivated by the declining debt in the late 1990s, and it provides additional empirical evidence; see Fleming (2000), Reinhart and Sack (2000).

[6] The fiscal year closing moved from June to September in 1977. Accordingly, spreads are July values until 1976 and October values since 1977. For more general specifications, one finds slopes estimates near zero (and insignificant) at debt/GDP over 55%, which motivates the simple regression. See Krishnamurthy and Vissing-Jorgensen (2008) for alternative specifications. Values for 2008-2010 are shown in Figure 1 as outliers.

inevitably extends “credit” to citizens who avoid repayment, debt financing also involves redistribution. Cukierman and Meltzer (1989) provide an excellent political-economy analysis of the intergenerational aspects; similar logic applies at shorter horizons. Public debt yields private benefits to those who would otherwise face credit limits or pay risk premiums. Social gains arise if the government faces lower borrowing cost than private intermediaries.

2.2. Requirements of Debt Sustainability

A second key question is what limits government debt. Can governments grant unbounded credit to its citizens? A plausible consequence of rising debt is a growing concern about monetization and default. Ratings agencies routinely use debt/GDP and related ratios, such a debt/revenues, to determine sovereign credit ratings.

It is instructive to distinguish fundamental questions about debt sustainability from expectational questions about confidence crises and credibility.

Consider fundamentals for now. Coherent answers about debt sustainability require several layers of analysis. First one must reject the still-popular notion that there is a free lunch, an opportunity for governments to issue debt without ever providing debt service by simply rolling it over with interest (also known as Ponzi finance). Second, one must ensure that the intertemporal budget constraint is satisfied. Third, one must worry about the government’s ability to provide the required debt service even under adverse conditions, which imposes additional constraints.

The possibility of rolling over the debt with interest cannot be dismissed lightly because the average interest charge on U.S. public debt has been below the average growth rate of the U.S. economy. This is documented in Table 1. One finds 4.4% nominal interest versus 5.5% growth for 1792-2010 and 4.7% interest versus 6.7% growth for 1915-2010.[7]

The differences between average growth and interest rates are greater than the average AAA-Treasury spreads. For 1925-2010 (the longest sample for yield spread data) the growth-interest difference was 1.4% and the average AAA-Treasury spread was 0.8%. Thus interest rates below the

[7] Because inflation cancels when one takes the difference of interest and growth, comparisons in nominal and real terms are equivalent; thus concerns about measurement error in inflation are immaterial.

average growth rate are not a special feature of government borrowing. Moreover, dynamically inefficiency does not explain these data (Abel et al. 1999). The average real return to capital of about 6-7% far exceeds the real growth rate of the economy. Thus the low interest rates on public debt must reflect the risk-aversion of investors who accept a low expected real return in exchange for the safety of government bonds.[8]

In a dynamically efficient economy, fiscal policy is subject to an intertemporal budget constraint and a limit condition on public debt (Bohn 1995). To be precise, let D_t be the public debt at the start of a period, S_t the primary surplus (primary meaning: excluding interest), and $u_{t,n}$ the period-t stochastic discount factor used for discounting state-contingent claims in period-($t+n$). The latter can be interpreted as investors' marginal rate of substitution between periods t and $t+n$. Rational investors will refuse to buy government bonds unless fiscal policy satisfies the intertemporal budget constraint

$$D_t = \sum_{n=0}^{\infty} E_t[u_{t,n} \cdot S_{t+n}]. \tag{1}$$

That is, current and future primary budget surpluses—revenues minus non-interest outlays—must have a risk-adjusted present value that adds up to current public debt. (See Appendix for a derivation.) A key implication is that *debt service cannot be avoided*, in the sense that primary surpluses must be positive sufficiently often and in states of nature that are valued sufficiently highly that (1) holds.

Risk-adjustment implies that present values depend not only on average values but also on covariances with systematic risks (i.e., risks reflected in the stochastic discount factor). For primary surpluses, one can write $E_t[u_{t,n} \cdot S_{t+n}] = E_t[u_{t,n}] \cdot E_t[S_{t+n}] + Cov_t[u_{t,n}, S_{t+n}]$, where $E_t[u_{t,n}]$ can be interpreted as the price of a safe n-period discount bond. So

$$D_t = \sum_{n=0}^{\infty} E_t[u_{t,n}] \cdot E_t[S_{t+n}] + \sum_{n=0}^{\infty} Cov_t[u_{t,n}, S_{t+n}]. \tag{2}$$

This equation can be satisfied with primary surpluses that are low or negative on average (so $E_t[S_{t+n}] < 0$), provided surpluses co-vary positively with systematic risk.

U.S. primary surpluses have indeed been negative: primary deficits averaged 0.3% of GDP for 1792-2010 and 1.2% for 1915-2010. The common claim that public debt must be backed by expected

[8] The magnitude of the equity premium is of course a long-standing puzzle (Mehra and Prescott 1985). My risk-based interpretation of return differences is consistent with Rietz (1978) and Barro and Ursua (2009).

primary surpluses is therefore not quite correct. U.S. public debt is backed entirely by the covariance terms in (2) that capture the value of safety promised to bond holders. In this sense, *U.S. fiscal policy has relied crucially on the perceived safety of Treasury debt.* Most U.S. debt is nominal, of course, and therefore not quite safe in real terms; but judging from interest rates, the premium for taking nominal risk has been negligible.

Put differently, neither of the two main paradigms of fiscal analysis—expected present value reasoning under dynamic efficiency and Ponzi finance under dynamic inefficiency—apply to U.S. data. Ponzi finance does not apply because debt must be backed by a risk-adjusted measure of primary surpluses. But expected primary surpluses can be negative, which means budget constraints cannot be written in terms of expected values.[9]

When average interest rates are below the average growth rate, average primary deficits are consistent with a stationary debt-GDP ratio. Next period's debt, $D_{t+1} = (1+r_{t+1})\cdot(D_t - S_t)$, equals current debt minus the primary surplus plus interest (at rate r_{t+1}). If GDP (Y_t) grows at rate y_{t+1}, next period's debt-GDP ratio can be written as

$$\frac{D_{t+1}}{Y_{t+1}} = \frac{(1+r_{t+1})\cdot(D_t - S_t)}{Y_{t+1}} = (\frac{1+r_{t+1}}{1+y_{t+1}})\cdot(\frac{D_t}{Y_t} - \frac{S_t}{Y_t}), \tag{3}$$

Under normal conditions—in years when growth is less than the interest rate—the debt-GDP ratio would decline if primary balance were equal to zero. Thus there is scope for primary deficits without causing a rise in the debt-GDP ratio. Figure 2 shows the history of U.S. debt-GDP ratios for 1792-2010 to illustrate that recent ratios around 35% (pre-crisis) were not much different from the ratios in the 1790s.[10]

Debt sustainability in a stochastic setting requires that the primary surplus must respond to economic shocks that disturb the debt-GDP ratio (Bohn 1998). Whenever the debt-GDP ratio rises due to low economic growth or unexpected spending needs, fiscal policy must respond to restore the

[9] A related point is that government bond yields cannot be used to discount future taxes, spending, and primary balances. Correct discounting must account for the distribution of these variables across states of nature (Bohn 1995).

[10] From 1915 to 2010, the debt-GDP ratio increased from 3% to 62%, or about 0.6% per year. The average primary deficit was much greater, 1.2% of GDP. The difference of 0.6% (=1.2%-0.6%), was covered by the growth-interest differential Similar logic applies to other sub-samples. The shorter the period, the more a sample average is influenced by large shocks, e.g., wars. Hence I report averages for long periods.

equality of debt and the present value of primary surpluses.

One systematic response is a fiscal reaction function for primary surpluses with a positive coefficient on the debt-GDP ratio. This is a simple response and sufficient for sustainability. Historically, U.S. primary surpluses have indeed responded positively to increases in debt/GDP. The response coefficient of primary surplus/GDP to debt/GDP ranges from 0.05 to 0.12, depending on sample period and specification (Bohn 1998, 2008). Thus U.S. fiscal policy has historically operated in a way that is consistent with the risk-adjusted intertemporal budget constraint.[11]

The empirical link between primary surpluses and debt is not mechanical. U.S. primary balances have responded negatively to output gaps and to above-normal military spending. Thus fiscal reaction functions are consistent with cyclical stabilization and they can accommodate wartime needs. There is also substantial residual variance, including episodes that have caused concerns about excessive deficits (e.g., in the 1980s). But such episodes are noise on a longer time scale, as every major debt buildup has been followed by a period of deficit reduction (e.g., as in the 1990s). And because debt changes gradually, only a long time scale is meaningful for fiscal sustainability.

Monetization and seignorage have not played a major role. Giannitsarou and Scott (2008) have used a cointegration approach to examine how fiscal imbalances are typically resolved. In 1960-2005 U.S. data, imbalances were resolved by almost entirely by responses in the primary surplus—about equally by higher taxes and reduced spending—and not by inflation. Seignorage is reflected in Federal Reserve transfers to the Treasury. It averaged 0.17% of GDP for 1915-2010 and is included in the budget. If this revenue were excluded, the average primary deficit would be 1.4% instead of 1.2% of GDP—a minor change.[12]

These findings do not preclude an insurance role for nominal debt. Nominal debt helps to reduce changes in debt/GDP by exploiting the negative correlation between inflation and GDP.

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[11] A variety of more complicated, time-varying responses would also suffice to ensure sustainability; but complicated, less stable behavior is more likely to encounter problems of credibility. See Davig and Leeper (2011) for a formal analysis of temporarily unstable debt.

[12] To be meticulous, the budget constraint should be adjusted if debt has a special collateral or liquidity value. One consistent approach is to value debt and primary surpluses under the regular pricing kernel and to count cost-savings from specialness as revenue item. If one measures specialness generously by attributing the entire AAA-Treasury spread to specialness, the revenues would average 0.27% of GDP for 1915-2010. The average primary balance would remain negative at -0.94%.

Questions of monetization versus primary surplus responses are about the remaining (unhedged) changes in debt/GDP.

In summary, the foundation of U.S. debt policy is the promise of safety for bondholders backed by primary surpluses only in response to a high debt-GDP ratio.

2.3. Implications of Safe Debt

An obvious attraction of a safe debt policy is that it provides cheap financing for entrepreneurial Americans. It is fitting that Americans hold foreign equities financed by debt and that almost half the Treasury debt is held abroad. Moreover, U.S. debt management has an element of "riding" the yield curve—using Treasury bills to finance long-term borrowings. This reduces average cost further, though at the expense of refinancing risk.

A serious downside of this policy is its welfare cost in a scenario of prolonged low or negative economic growth. Low growth would drive up the debt-GDP ratio and eventually require sustained primary surpluses—tax increases or spending cuts—and this in a difficult economic situation. The U.S. has never fully experienced this downside. The worst low-growth episode, the Great Depression, was ended by WWII with debt/GDP under 50%. (See Figure 2.) Post-1990 Japan is perhaps a better illustration.

The dynamics of safe debt implies that slow growth causes a high debt-GDP ratio. Reinhart and Rogoff (2010) find low growth conditional on *gross* debt over 90% of GDP, in the US and abroad, and they suggest high debt might hurt growth. This conclusion seems questionable for the U.S., where gross debt exceeded 90% of GDP only in fiscal years 1944-50. An obvious causal factor is World War II, with demobilization at the end reducing measured growth. In Japan, gross debt/GDP started off at 68% in 1990 (net debt 15%) and breached 90% only after a period of slow growth.

Another serious concern is the potential for credibility problems. A positive response of primary surpluses to debt is sufficient to make the debt-GDP ratio stationary, but it does not preclude episodes with high debt/GDP in response to negative shocks. Such episodes test the government's credibility because the fiscal benefits from default and from inflation are increasing in the debt-GDP ratio. This concern touches a more general problem: the challenge of managing expectations.

3. The Challenge of Managing Expectations

Rational investors are forward looking. Policies can change. Hence investors may worry about debt repayment in the future even in a country with a long history of fiscal sustainability and no defaults.

Two distinct issues deserve attention: concerns about a structural break and the possibility of a confidence crisis based on self-fulfilling expectations.

3.1. Inflation Fears

Concerns about a structural break in U.S. fiscal policy could upset investor expectations. The financial problems of pay-go Social Security and Medicare are well known. Investors' concerns are likely reinforced by official projections of persistent primary deficits even under optimistic assumptions, by open-ended credit guarantees to mortgage lenders, and by uncertainty about the fiscal implications of new health care programs. Estimated fiscal reaction functions call for primary surpluses when the debt-GDP ratio rises above a critical value, which is around 55-60% under normal conditions. Current official projections assume substantial and unending primary deficits at debt-GDP ratios well above this range (see *U.S. Budget 2012* and Congressional Budget Office, 2011). Such projections can reasonably be interpreted as sign of a structural break.[13]

The nature and timing of a shift in investor expectations is difficult to determine. History shows that expectations can shift suddenly; see Reinhart and Rogoff (2009). The primary concern reported in the media is a fear of inflation as a consequence of rising debt.

Fiscal gains from inflation depend on debt structure and ownership (Calvo and Guidotti 1990; Bohn 1991; Aizenman and Marion 2009). The over-90% non-indexed share and near-50% foreign ownership of U.S. debt favor inflation, but the short duration limits the gains. About 30% of U.S. nominal debt is due within a year and 70% within five years (as of June 30, 2011; see Table 2). To calibrate the gains, suppose inflation were increased permanently to 4%, the value suggested by Blanchard et al. (2010) as new inflation target. A jump to 4% inflation—instantaneously and

[13] A cautious interpretation is appropriate, however, because scary projections are arguably an element in the political process that encourages deficit reduction.

permanently—would devalue U.S. public debt by about 4.3% of GDP, which is a one-time gain.[14] About ¼ of bondholder losses would fall on Federal Reserve holdings, leaving a net fiscal gain of 3.3% of GDP. The fiscal gain would be greater if inflation increased more; it would be smaller if inflation increased gradually or if the increase were reversed before all debt matures.[15] It is unclear, however, under what conditions—if any—politicians would find such modest gains large enough to push the Federal Reserve into sacrificing price stability. Indeed, economists who favor higher inflation tend to invoke Phillips curve arguments and not fiscal gains. This suggests that to the extent politics influences inflation, it's more about jobs than about nominal debt.

If inflation fears were tightly related to debt, this should be reflected in spreads between nominal and inflation-indexed yields. Between February 2007 (pre-crisis) and June 2011, Congressional Budget Office projections of 5-year-ahead debt/GDP almost tripled from 33% to 85%. However, inflation implicit in 10-year yields has remained almost unchanged (about 2.3%), and is similar to the pre-2007 average; see Figure 3. Thus the debt-inflation link is still more a perception than a reality.

Inflation fears are nonetheless difficult to dismiss because throughout history, countries in trouble have debased their currencies (Reinhart and Rogoff 2009). The logic of Sargent and Wallace (1981) provides theoretical support, and the fiscal theory of the price level seems to make inflationary solutions intellectually respectable.

The fiscal theory of the price level is problematic in this context because it treats the existence of nominal debt as given. Once nominal debt is outstanding, of course it can be inflated away. Ex ante, however—before nominal bonds are issued—the government must convince bond buyers that debt will pay a competitive real return. Put differently, the government must overcome the time consistency

[14] See Appendix for details. My approach differs from Aizenman and Marion (2009). The gains here are for moving *to* a new inflation level (flat 4%) and account for expected inflation implicit in the yield curve; and present values are computed security-by-security for all outstanding Treasury securities. Aizenman and Marion use average *maturity* as measure of interest rate sensitivity and they estimate gains from an equal increment in inflation at all maturities. Averages across securities can be used only when one considers equal inflation changes at all maturities; and then the correct summary statistic is the average *duration* of nominal debt (3.8 years as of June 2011). Since the nominal debt/GDP (excluding Fed holdings) is about 50%, the fiscal gain per 1% increase in inflation can be computed easily as 1% times 3.8 years duration (implying 3.8% debt devaluation) applied to 50% debt/GDP, which implies a gain of 1.9% of GDP.

[15] Because most of the inflation gains accrue within the first few years, the net gain is sensitive to delays (say, due to price rigidities or implementation lags). For example, a one-year delay in going to 4% inflation would reduce the net fiscal gain from 3.3% of GDP to 2.2%, i.e., by about one-third.

problem, and this is accomplished credibly with an independent central bank and Ricardian monetary-fiscal coordination. In a Ricardian regime, it is destructive for credibility to portrait the intertemporal budget constraint as a mere equilibrium condition, because investors can reasonably interpret a refusal to respect this budget constraint as statement of intent to pursue time-inconsistent (inflationary) policies—to subordinate monetary policy to fiscal pressures.

Quantitatively, U.S. public debt is small relative to implicit pay-as-you-go obligations: $9.7 trillion debt versus about $43 trillion closed-group liability for social insurance, mostly Social Security and Medicare (see *2010 Financial Report of the U.S. Government*). Hence a credible plan to address pension and health care cost should help calm inflation fears.

3.2. Is a Confidence Crisis Possible?

A confidence crisis is a serious concern because the U.S. Treasury relies on serial refinancing as it issues short-term debt backed by tax revenues in the far future. The U.S. government is in effect operating like a bank and therefore subject to bank runs. In game theoretic terms, a confidence crisis can occur even along an otherwise sustainable path if the market for debt has multiple equilibria.

Table 2 documents the maturity structure of Treasury debt in June 2011. Maturing within the next year (by June 2012) are $2.58 trillion in nominal debt, which includes $1.51 trillion Treasury bills. Also due within a year are $201b nominal coupon payments, plus $40b principal and interest on inflation-indexed bonds, adding up to a debt service requirement of $2.78 trillion. This first-year debt service is substantially greater than the federal government's annual revenues (about $2.2 trillion in fiscal year 2011). Moreover, more than $1.2 trillion is due within three months, which is more than twice the flow of revenues. Thus refinancing is essential. This places U.S. debt into Cole and Kehoe's (2000) "crisis zone," a range where self-fulfilling debt crises *are* possible.

Most models of confidence crises assume that there is one "good" scenario in which investors expect no default and refinance the debt at default-free interest rates. The good scenario is an equilibrium if government satisfies its intertemporal budget constraint and does not intend to default when financing is available. In the crisis zone, there is also a "bad" equilibrium, where default is unavoidable without access to refinancing—essentially a "run" on sovereign debt. If investors expect a default and refuse to refinance, their expectations will be confirmed. (See Alesina et al. 1990 for a simple model of this type.)

One could speculate about the aftermath of a default—say, ask if a refusal to refinance is rational if a suspension of payments were followed by sufficient payoffs later—but experience suggests that fears of illiquidity *per se* are destructive.

In a broader sense, the existence of a bad equilibrium depends on the Federal Reserve, because as last resort, the Federal Reserve could monetize the debt. The logic follows Sargent and Wallace's (1981) famously unpleasant monetarist arithmetic, but applied to a path off the desired equilibrium. Because the U.S. government is undoubtedly too big to fail, a Fed bailout is likely. Thus a default is unlikely. However, monetization points to a high-inflation "bad" equilibrium as modeled by Calvo (1988): Investors who expect high inflation may demand interest rates that are prohibitive at normal inflation rates. Monetization conditional on refinancing problems could rationalize such expectations. The result would likely be a jump in interest rates, an expansion in high-powered money, and a sharp drop in the dollar.

The rationality of a speculative attack depends on how the Federal Reserve and the Treasury would handle a failed Treasury auction—a lack of buyers. One contingency plan might be a shift to selling long-term inflation-indexed securities (to avoid or quickly reverse monetization). Inflation-indexed bonds are in effect senior to nominal debt if a refinancing cutoff is expected to trigger monetization and not default. A maturity structure that distributes real debt service uniformly over a long horizon would largely remove the necessity of future refinancing. Hence long-term inflation-indexed bonds should be marketable even in a confidence crisis.[16] Given this option, a speculative attack on nominal debt would not be rational.

If a confidence crisis is triggered by concerns about refinancing, a high level of debt is a complicating factor, but the danger depends more on the debt structure and on contingency planning than on the level of debt. If a confidence crisis were triggered by doubts about fundamental solvency,

[16] Note that U.S. inflation-indexed debt currently has long maturities and no spikes in the repayment schedule (see Table 2). If refinancing were cut off, modest primary surpluses—less than $100 billion per year—would suffice to redeem all indexed obligations over time..

in contrast, a shift to inflation indexing would not suffice. It could even fuel inflation fears because extracting a given inflation gain from a smaller nominal debt would require a higher rate of inflation. Then cuts in current and projected deficits would be essential—a credible display of "debt aversion" (Calvo and Guidotti 1990). Even then, confidence might be difficult to restore. Thus there is potentially destructive interaction between concerns about a structural break in policy and the problem of multiple equilibria.

Hopefully the U.S. government's track record—a long-standing AAA rating, a history of sustainable policies and no defaults—will ensure that the good equilibrium continues to be the focal point for coordinating investor expectations. But investor confidence should not be taken for granted. All major ratings agencies have recently started to question the U.S. government's credit rating, which is a disturbing sign.

The central bank's role as the government's lender-of-last-resort in a crisis deserves emphasis in view of the European debt crisis. Because euro-zone members cannot monetize their debts, their options regarding debt management are more comparable to the U.S. states than to the federal government. In most U.S. states, debt issues are constrained by balanced budget rules. State debts are only 8% of gross state product on average, and no more than 20% in any state (as of 2007-08, from *U.S. Census*). Moreover, state debts are mostly long-term and linked to capital projects. There is no need to refinance and hence no run risk.[17] While Europe has long strived to limit debt-GDP ratios, debt structure and refinancing issues received much less attention—until the Greek crisis. The apparent contagion thereafter suggests that access to refinancing is now a central issue. The challenge for Europe is to eliminate the run equilibrium. A comparison to the U.S. suggests that a solution will require either guaranteed European Central Bank funding (restoring access to fiat money) or a difficult transition to a new steady-state with much lower national debts that are financed exclusively with long-term bonds (similar to U.S. states).[18]

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[17] The exceptions confirm the principle: states in financial trouble (e.g. California) are at the mercy of Wall Street in large part because they have violated the rules against short-term and general-fund borrowing. Solvency is also a concern in some U.S. states, but fueled more by unfunded state pension obligations than by debt.

[18] The natural funding instrument would be consols—perpetual bonds that need no refinancing. It should not surprise that they were invented at a time of long-term funding needs without fiat money—Britain in the 1750s.

The euro-zone as a whole can monetize debt, of course, which may explain why countries like Germany and France are not threatened by refinancing risk: everyone understands that they are too big for the European Central Bank to let them fail.[19]

4. Conventional Macroeconomic Effects

Though the paper focuses on solvency issues, the standard macro effects of public debt should be noted. The key point is that the negative effects are gradual and arguably modest, therefore manageable and not the main cause of concern.[20] Brief comments should suffice because the economics are well explained in survey articles, e.g., Elmendorf and Mankiw (1999).

Conventional macro theories of government debt assume a world with well-functioning financial markets. Debt is issued to finance budget deficits. Unless private savings rise by an offsetting amount, the increased supply of government bonds raises interest rates. Higher interest rates raise the required return on private borrowing and thereby crowd out capital investment. A lower capital stock reduces the economy's productive capacity and thus reduces future GDP. The damage is magnified if debt service requires distortionary taxes. If debt attracts foreign buyers, the interest rate and implied crowding-out effects are dampened, but then payments to foreign lenders reduce future GNP. Either way, debt accumulation reduces future consumption opportunities.

A vast empirical literature has examined the strength of these effects. The most striking general insight is that significant effects are remarkably difficult to find. A leading explanation is Ricardian Neutrality, the hypothesis that private savings increase one-for-one with government debt because households recognize that debt implies future taxes. Studies of tax rebates find that consumers typically save a large fraction of a tax rebate. Shapiro and Slemrod (2009) suggest savings of two-thirds. Only the remainder—the deviation from neutrality—exerts upward pressure on interest rates.

Interest rates effects are nonetheless significant. Engen and Hubbard (2005) provide estimates for a range of specifications, and a survey of other studies. They find that a one-percentage point increase in 5-year-ahead Congressional Budget Office projections of debt/GDP raises the 10-year

[19] The ECB has bought Greek and other crisis-country debt already, but there is no credible commitment looking forward.
[20] As noted earlier, short-run multiplier effects may be *positive*. The challenge here is to document negative effects.

Treasury yield by 0.028%. This estimate is significant at the 10% level and economically sensible, but subject to specification uncertainty. Because the transmission mechanism for other macro effects goes through interest rates, the interest rate effect puts an upper bound on crowding-out and output effects. Elmendorf and Mankiw (1999) calculate that a 50%-of-GDP increase in debt would reduce national income in the long run by only about 3%. Though these conventional effects of debt are harmful, they are modest in size, take effect gradually, and could be reversed straightforwardly—more easily than a confidence crisis.

5. Conclusions: A Precautionary Case for Keeping Debt Low

Yields on long-term inflation-indexed Treasury bonds, at less than two percent as of July 2011, are below the long-run growth rate of the U.S. economy. Treasury bill yields are near zero, despite positive inflation. This means the United States is in an extraordinarily privileged position, having access to credit in fiat currency and at interest rates that not require debt service except under unusual circumstances.

Privileges are at risk when they are overused. A serious consequence of rising debt is to create reasonable doubts about the government’s solvency and about monetary stability. Such doubts are created by public debt and by implicit obligations such as Medicare and social security. Because privileges are worth protecting, there is a precautionary case for keeping U.S. government obligations low enough that the safety of U.S. debt will remain unquestionable.

Appendix

A1. Description of U.S. fiscal data

The fiscal data reported in the text, Figure 2, and Table 1 are taken from Bohn (2008), which covered 1792-2003, and updated from the *U.S. Budget 2012*. Years refer to fiscal years unless noted. Debt is recorded at book value. Table 2 is constructed from the *Monthly Statement of the Public Debt*, June 30, 2011. In Table 1, the interest rate is the ratio of (nominal) interest payments on Treasury debt divided by the average of debt outstanding at the beginning and end of a fiscal year. Because securities are redeemed at par and original issue discounts are amortized, this interest rate measures the average rate of return until maturity. For shorter periods, the interest rate differs from the total return that one would obtain from market values because capital gains are disregarded. However, the objective here is to measure average returns over long samples, which (assuming ergodicity) can be interpreted as expected values. For this purpose, buy-and-hold is a reasonable assumption. Attempts to estimate market values would likely introduce measurement errors—noise from high-frequency fluctuations in interest rates—especially for historical periods with limited data. Growth and inflation in Table 1 refer to GDP growth and to the percentage change in the GDP deflator. The 1792-2010 sample is the longest available; 1915-2010 covers the Federal Reserve era. For both periods, Table 1 shows an average interest rate less than the average growth rate.

A2. Fiscal Gains from Inflating the Nominal Debt

The inflation gains reported in Section 3.1 are computed from Treasury debt as listed in the *Monthly Statement of the Public Debt*, June 30, 2011 and from Federal Reserve interest rate data (release H.15 for June 2011). Spreads between nominal and inflation-indexed yields are interpreted as initial expected inflation rates; they range from about 1.1% at short maturities to about 2.6% at 10-30 years. The basic thought experiment is to increase inflation to 4%, starting July 1, 2011. Holding inflation-indexed yields constant, nominal yields are assumed to increase such that implied inflation equals 4% at all maturities. The increased nominal yields are used as discount factors for valuing principal and interest on non-indexed debt securities. This calculation yields a debt reduction equal to 6.7% of the outstanding nominal debt. This value is multiplied by the ratio of outstanding nominal debt to GDP (60.4%) to obtain the 4.0% of GDP estimated inflation gain stated in the text. The value of indexed debt is left unchanged. The calculations can be modified easily to model other scenarios. Scenarios with constant shift in the yield curve are be particularly simple because the debt reduction can then be expressed as product of inflation change and debt duration. The duration of U.S. nominal debt was 3.8 years in June 2011.

A3. Derivation of the Intertemporal Budget Constraint [equation (1)]

The budget identity $D_{t+1} = (1+r_{t+1})(D_t - S_t)$ specifies that debt at the start of period *t+1* equals initial debt D_t minus non-interest surplus S_t plus interest on end-of-period debt at rate r_{t+1}. All variables are treated as stochastic. Iterating forward for *k* periods, one obtains $D_{t+k} = R_{t,k} D_t + \sum_{n=0}^{k-1} R_{t+n,k-n}(-S_{t+n})$, where $R_{t,k} = \prod_{i=1}^{k}(1+r_{t+i})$ captures compound interest. Under general conditions (see e.g. Duffie 1992), there exists a stochastic discount factor $u_{t,k}$ so that the period-*t* value of state-contingent payments in period-*(t+k)* can be written as the conditional expectation of payments multiplied by $u_{t,k}$. Since debt D_{t+1} is supposed to have value $D_t - S_t$, the interest rate r_{t+1} must satisfy $D_t - S_t = E_t[u_{t,1} D_{t+1}] = E_t[u_{t,1}(1+r_{t+1})(D_t - S_t)]$, so $E_t[u_{t,1}(1+r_{t+1})] = 1$. Similarly, $E_t[u_{t,k} R_{t,k}] = 1$ for any *k*. Applied to D_{t+k}, this implies

$$E_t[u_{t,k} D_{t+k}] = E_t[u_{t,k} R_{t,k}] D_t + \sum_{n=0}^{k-1} E_t[u_{t,k} R_{t+n,k-n}(-S_{t+n})] = D_t - \sum_{n=0}^{k-1} E_t[u_{t,n} S_{t+n}] \qquad \text{(A1)}$$

In a dynamically efficient economy, rational investors impose the transversality condition $E_t[u_{t,k} D_{t+k}] \to 0$ as $k \to \infty$ (see Bohn 1995, 2008). Taking the limit in (A1), one obtains $D_t = \sum_{n=0}^{\infty} E_t[u_{t,n} S_{t+n}]$, which is equation (1).

Note that if r_{t+1} is known in period *t*, then $1 = E_t[u_{t,t+1}(1+r_{t+1})] = E_t[u_{t,t+1}](1+r_{t+1})$, so the discount factor for safe assets is $E_t[u_{t,t+1}] = 1/(1+r_{t+1})$. Even if debt is safe, it would be wrong to discount S_{t+n} or D_{t+k} in (A1) or (1) by safe interest rates, unless the exact *amounts* of the future surpluses and outstanding debts were known at time-*t* or uncorrelated with the stochastic discount factors. All equations above hold in nominal or real terms provided the stochastic discount factors are scaled accordingly.

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Table 1: Average U.S. interest rates and growth rates

Period	Interest - Growth Difference	Interest Nominal	Growth Nominal	Interest Real	Growth Real	Memo: Inflation
1792-2010	-1.1%	4.4%	5.5%	2.8%	3.9%	1.5%
1915-2010	-1.9%	4.7%	6.7%	1.5%	3.4%	3.2%

Note: See appendix for data description. The interest-growth differences are computed as (1+interest)/(1+growth)-1.

Table 2: The Maturity Structure of Marketable U.S. Public Debt

(June 30, 2011. All amounts in $billions)

Year	Year ending June of	Nominal Treasury Securities			Inflation-indexed Securities (at June 2011 prices)			Total
		Maturing Principal	Coupon Payments	Debt Service	Maturing Principal	Coupon Payments	Debt Service	Debt Service
1	2012	2,582	201	* 2,782	27	13	40	2,823
2	2013	1,219	181	1,401	45	13	57	1,458
3	2014	884	162	1,045	66	12	78	1,123
4	2015	631	145	775	67	10	78	853
5	2016	705	126	832	53	10	63	894
6	2017	506	108	615	42	9	50	665
7	2018	509	89	598	33	8	41	639
8	2019	238	74	311	31	7	38	349
9	2020	314	64	378	36	7	42	420
10	2021	285	51	336	71	6	77	413
Memo: Totals by decade								
	July 2011 to June 2021	7,873			470			9,074
	July 2021 to June 2031	278			156			592
	July 2031 to June 2041	510			39			700

Note: The table shows annual debt service (maturing principal and recurring coupon payments) on marketable Treasury securities outstanding on June 30, 2011. Marketable debt accounts for $9.3 of the $9.7 trillion public debt; excluded are about $400 billion non-marketable issues, mostly savings bonds and bonds held by state and local governments.

* About $1,221 billion of the year-1 debt service is due within the first three months (by Sept.30, 2011).

Figure 1: The AAA-Treasury Yield Spread and the U.S. Debt-GDP ratio, 1925-2010

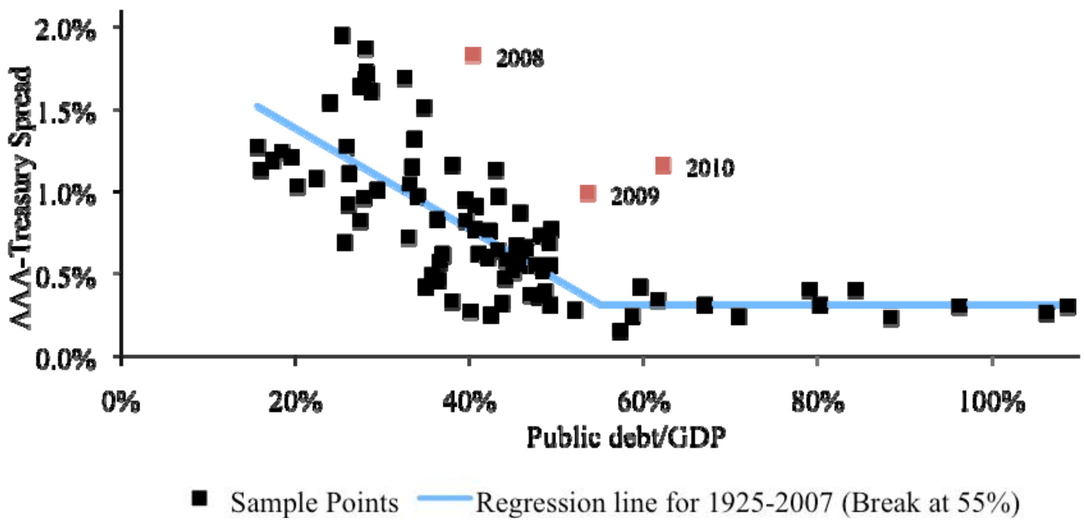
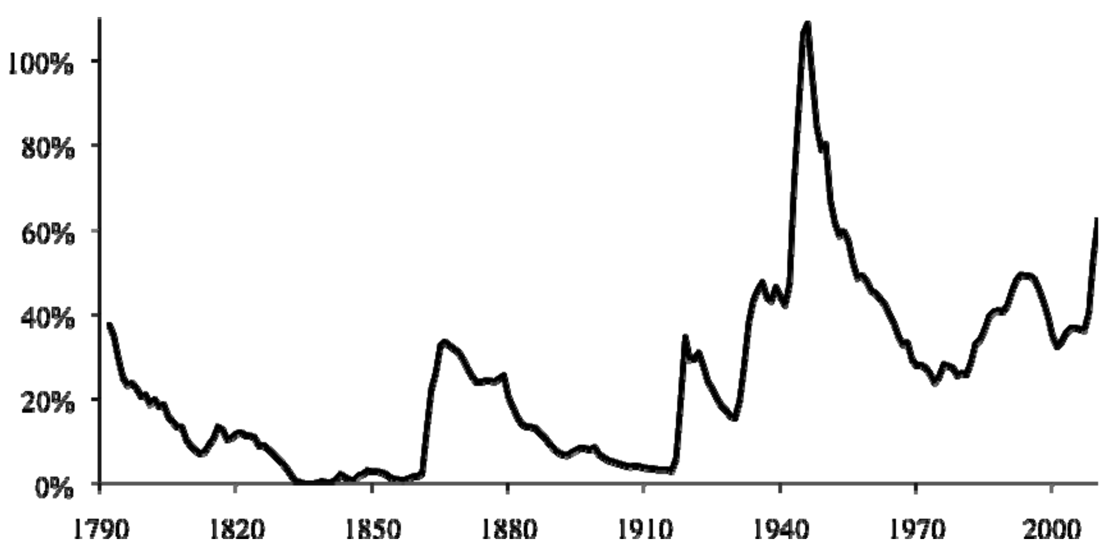
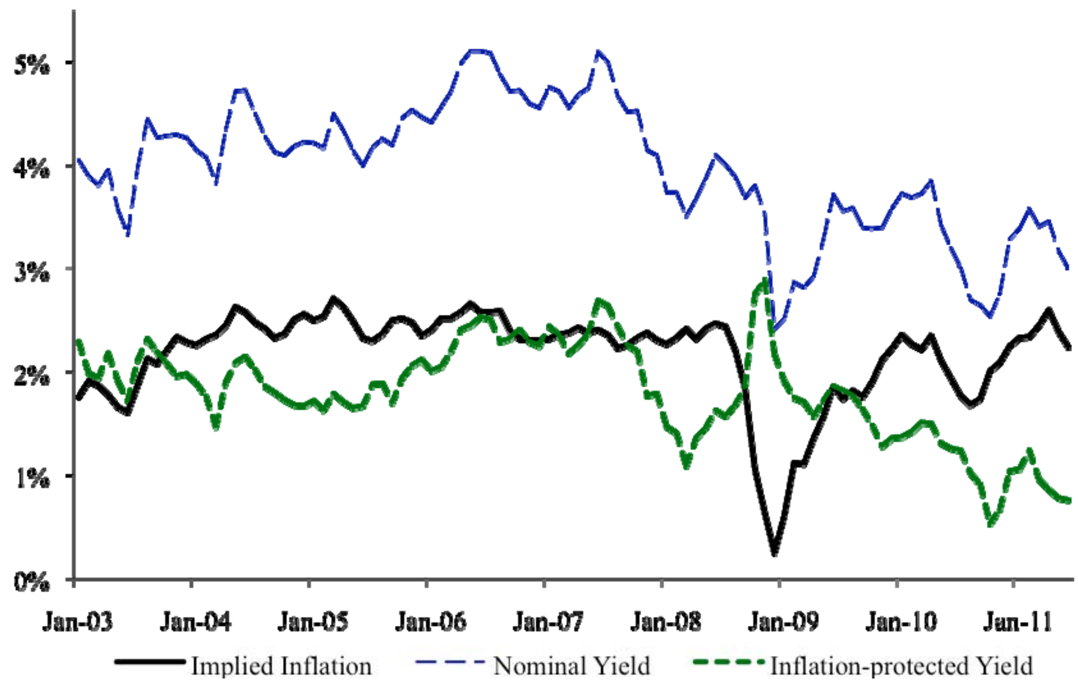


Figure 2: The U.S. Debt-GDP ratio, 1792-2010



Note: See appendix for data description.

Figure 3: Inflation implied by nominal and inflation-protected 10-year Treasury yields



Note: U.S. Treasury yield data are from Federal Reserve release H.15, monthly.