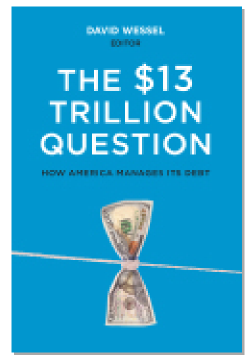
The $13 Trillion Question

David Wessel



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THE OPTIMAL MATURITY OF GOVERNMENT DEBT

Robin Greenwood, Samuel G. Hanson, Joshua S. Rudolph, and Lawrence H. Summers

The central task of debt management is to decide which debt instruments the government should issue in order to finance itself over time. What programs the government should pursue and whether the government should finance its current expenditures by collecting taxes or by borrowing are outside the purview of debt management.

Historically, U.S. debt managers had three main instruments available to them: Treasury bills with a maturity of less than one year, intermediate-maturity notes with maturities up to ten years, and long-term bonds. Inflation-protected securities were introduced in 1997 and floating-rate notes were added in 2014. The maturity structure of the government debt has fluctuated significantly over time in response to the evolving fiscal outlook and changing debt management practices. The average maturity of Treasury marketable securities outstanding went from sixty-eight months in January 2000 to fifty-five months in January 2007, before the onset of the financial crisis, to sixty-eight months in December 2014.[1]

1. See 2015Q1 Quarterly Data Release (www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Documents/2015%20Q1%20Quarterly%20Data%20Release.xls).

In this chapter we address optimal government debt management policy on a consolidated basis. We begin by describing the considerations the government must weigh in deciding the optimal maturity structure of the debt. We then show how similar considerations can help determine other features of the debt structure, such as the mix between inflation-protected securities and traditional bills, notes, and bonds.

The Optimal Maturity Structure of the Net Consolidated Government Debt

Standard economic theory offers surprisingly little guidance as to how officials should manage the government debt. In the textbook theory of government financing, it is irrelevant whether the government decides to finance itself using debt or taxes, or whether the government borrows using short-term or long-term debt. This surprising view—known as "Ricardian equivalence"—was first postulated by David Ricardo in 1820 and formalized by Robert Barro in 1974. Barro's proposition identifies a set of strict assumptions under which the manner in which the government finances its expenditures using taxes and various types of debt has no effect on household consumption and well-being.[2] Theories of optimal government debt management hinge on failures of one or more of these assumptions.

The strict assumptions underlying Ricardian equivalence proposition are that (1) taxation creates no deadweight losses, (2) government debt is valued by investors solely for its cash flows in different states of the world (i.e., investors do not prize the liquidity of government debt in the same way they value the liquidity of cash or checking deposits), and (3) capital markets are frictionless (Barro 1974).[3] If Ricardian equivalence holds, then not only is

2. Ricardian equivalence is the public finance analog of the Modigliani-Miller (1958) theorem, which states that, under certain strict conditions, the way that a corporation finances itself has no effect on the firm's total value.

3. Formally, the assumption that financial markets are frictionless means that any agent's marginal utility of income must price all assets in the same way. Thus, there cannot be important constraints to participating in financial markets, borrowing constraints, short-selling constraints, agency frictions, or other segmentation that leads agents to assign different values to the same asset. Proofs of Ricardian equivalence also assume that agents have infinite horizons, which is often cited as a reason that Ricardian equivalence may fail. However, lifetimes are long enough that

the maturity structure of the debt economically irrelevant, but deficit-financed spending is also irrelevant.

A simple example illustrates the Ricardian logic. Consider a government with an initial accumulated deficit and no future expenditures that must decide whether to finance its deficit by issuing short- or long-term bonds. If the government finances itself solely through the issuance of short-term debt, then the government will have to raise taxes if short-term interest rates rise. However, the rise in interest rates will leave a household that is lending short-term to the government with a bit more in its bank account. Since the government's sources of funds (taxes and proceeds from issuing new debt) must equal its uses of funds (paying off maturing debt), the gain in the household's bank accounts must *precisely* offset the increase in taxes. As a result, issuing more short-term government debt increases the interest rate exposure of households' future tax liabilities, but has a perfectly offsetting effect on the value of their portfolio of bond holdings. It follows that the government should be completely indifferent between issuing short- or long-term debt. This reflects the fact that, in a Ricardian world, government debts are not a form of net wealth for private actors: they simply reflect the present value of future tax liabilities.

Modern debt management policy hinges on four important real-world deviations from the assumptions underpinning Barro's Ricardian equivalence proposition. First, certain types of government debt are net wealth in the sense that they offer investors a valuable set of "liquidity services" above and beyond their financial cash flows: government debt is a safe store of value that can be quickly converted into cash. For example, short-term Treasury bills provide investors with many of the same liquidity and storage services as cash or bank deposits. As a result, the yields on T-bills appear to embed a significant "liquidity premium"—they are lower than they would be in the absence of these liquidity services. Recognizing these liquidity benefits, the government can improve welfare by issuing short-term debt securities that offer investors these special liquidity services.

Second, debt management can play an important role in managing fiscal risk. A standard rationale for fiscal risk management stems from the insight that taxes influence behavior in the private economy through the effects on incentives. All else equal, society is better off when taxes are low and smooth

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finite lifetimes cannot account for meaningful failures of Ricardian equivalence (Poterba and Summers 1987).

over time (Barro 1979; Lucas and Stokey 1983). A government that does a lot of short-term borrowing exposes its people to the risk that interest rates change, forcing the government to raise taxes in the future. Going further, a government that does a lot of short-term borrowing may be vulnerable; if there is a widespread and growing fear about a government's inability to service its debts, investors may demand sharply higher interest rates or even to refuse to buy short-term debt in a self-fulfilling panic akin to a bank run. Political economy factors may also play a role because even short-lived shocks to deficit financing may lead to cuts in valuable government programs.[4]

Third, real-world capital markets operate with a variety of frictions not envisioned in the Ricardian benchmark. The most relevant friction is that the marginal holder of long-term government bonds is a specialized fixed-income investor who demands more compensation for bearing interest rate risk than the average taxpayer. This segmentation explains why quantitative easing—the purchase of long-term bonds by the Federal Reserve—can influence the prices of financial assets and can therefore function as a tool for managing aggregate demand. Specifically, shortening the maturity of the net government debt causes specialized fixed-income investors to bear less interest rate risk, and may therefore lower the long-term interest rates relative to short-term rates. Quantitative easing (QE) rests on the belief that such interest rate changes are passed through to private borrowers, helping to stimulate long-term corporate investment, residential construction, and consumer spending.

Fourth, because private financial intermediaries can also create highly liquid short-term debt, debt management policy may be able to promote financial stability by altering the behavior of intermediaries (Pozsar 2011, 2012; Krishnamurthy and Vissing-Jorgensen 2013; Greenwood, Hanson, and Stein 2015). Specifically, by issuing more short-term debt, the government can help satiate the public's demand for liquid short-term debt, reducing the private sector's incentives to issue it. In this way, the government may be able to curb the amount of liquidity transformation in the financial system, limiting the likelihood and severity of future financial crises.

4. For instance, Auerbach and Gale (2009) find that, controlling for the difference between actual and potential GDP, roughly one-quarter of the annual change in the federal deficit from 1984 to 2009 was offset by policy, with changes in outlays accounting for slightly more of the response than changes in revenues.

The framework for government debt management that we develop relies on the four real-world frictions outlined above. We start by exploring the implications of the first two frictions and describe a model developed by Greenwood, Hanson, and Stein (2015). In that model, the government pursues a trade-off between its desire to issue "cheap" securities that provide liquidity services and its desire to manage fiscal risk. This simple trade-off model captures the essence of the traditional debt management problem, as framed by Treasury officials: how to finance the public debt at the lowest cost while being prudent from the perspective of fiscal risk.

After describing this trade-off model of government debt policy, we extend it to consider the two nontraditional goals of debt management suggested previously: promoting financial stability and managing aggregate demand. Although these two policy goals are hardly new, the idea of using debt management policies to pursue them has emerged only in recent years. Because our model already considers a trade-off between competing government objectives, it is well suited for analyzing these nontraditional objectives of debt management.

Our framework suggests that optimal debt management hinges on a set of potentially quantifiable forces. Although a rigorous analysis of this sort is beyond the scope of this chapter, we provide some educated guesses regarding the likely magnitude of the relevant forces, describing how they may vary over time. We argue that over the long run, the optimal maturity structure of government debt may be shorter than the government has entertained historically. We explore this idea by describing a counterfactual financing history of the federal government in which the government relies on a much shorter-term funding mix in the postwar era. We also argue that the optimal maturity structure of debt may vary over time, in a direction that is correlated with the path of monetary policy.

A Trade-Off Model of Government Debt Maturity

We start with the question of the optimal maturity structure of the debt. Greenwood, Hanson, and Stein (2015, hereafter GHS) consider a government that trades off two desires: to issue "cheap" securities and to manage fiscal risk.

This trade-off framework captures the essence of debt management as described by Treasury officials. For instance, in 1998, Assistant Secretary Gary

Gensler emphasized the importance of "achieving the lowest cost financing for taxpayers." At the same time, he noted that "Treasury finances across the yield curve" because "a balanced maturity structure mitigates refunding risks." Ten years later, in 2008, Director of the Office of Debt Management Karthik Ramanathan echoed that sentiment, stating that the primary objective of debt management was to achieve the "lowest cost of financing over time," while emphasizing that it is crucial to "spread debt across maturities to reduce risk."

What does it mean to issue "cheap," or to achieve "the lowest cost financing over time"? It cannot simply mean issuing securities with a low current yield-to-maturity. Why? Short-term rates may be low compared to long-term rates because short-term rates are expected to rise in the future. In this case, issuing short-term debt results in low current interest payments, but will likely lead to higher interest payments in the future. This implies that the government should be indifferent between rolling over short-term debt and issuing long-term debt.

The nature of what ought to count as "low cost" goes beyond adjusting for the expected path of future short-term interest rates. Suppose that capital markets are frictionless—all households assign the same value to all financial assets, but long-term bonds offered a higher expected return than short-term bills because of a risk premium, perhaps because long-term bonds were expected to underperform short-term bills in recessions when the average household is hurting. Should the government try to protect households from this risk by issuing shorter-term securities? No! Such a debt management strategy would simply shift risk between households' bond portfolios and their tax liabilities, but leaves households bearing the same total amount of interest rate risk. In the absence of capital market frictions, issuing more short-term debt wouldn't change a thing.

A role for debt management arises if there is a special, non-risk-based demand for particular types of government securities—that is, if different securities provide different amounts of liquidity services, leading their yields to embed differential liquidity premia.[5] Short-term Treasury bills typically embed a larger liquidity premium than long-term Treasuries because bills

5. If all forms of government debt provide the same amount of liquidity services, then Ricardian equivalence fails and the overall quantity of government debt will matter; however, the composition of the debt—that is, debt management policy—would be irrelevant.

provide more of the valuable services offered by traditional money (e.g., tremendous liquidity and absolute safety as a near-term store of value).

However, when Treasury debt managers say they are trying to achieve the lowest cost financing for taxpayers, we sense that they have more in mind than capturing differential liquidity premia. Specifically, it seems that—all else being equal—debt managers might prefer a shorter average maturity for the debt in order to conserve on the "term premium" that compensates long-term bond investors for bearing interest rate risk. Is economizing on the term premium a coherent rationale for shortening the average maturity of the debt? If markets are frictionless and all households assign the same value to long-term bonds, then the answer is a clear "no." However, if markets are segmented and long-term bonds are priced by specialized investors who are more worried about interest rate risk than the typical taxpayer, then the government can make the typical taxpayer better off by borrowing short.[6] Since this same segmented market logic underlies the portfolio balance channel of QE, conserving on the term premium may be a defensible rationale for lowering the average maturity of the debt.[7]

Turning to the other side of the trade-off, the government also seeks to minimize fiscal risk, meaning that the cost of servicing the debt should not be too volatile. Issuing too much short-term debt exposes the government to the possibility that interest rates may rise. The formal justification for fiscal risk management is that government should try to avoid budget risk because this directly leads to volatility in tax rates (GHS). And because the marginal deadweight costs of taxation are increasing with the level of taxes—that is, the costs are *convex*—this generates a desire to smooth taxes over time. The reasons to minimize fiscal risk likely go well beyond any deadweight costs associated with volatile taxes. For example, a very short-term maturity structure might make the government vulnerable to self-fulfilling crises akin to a bank run. Furthermore, one may want to limit budget volatility to avoid

6. If markets are segmented, the expected tax savings from conserving on the term premium demanded by specialized bond investors can more than compensate the typical taxpayer for the additional tax volatility.

7. For instance, in 1993 some of President Clinton's economic advisers argued that it would be desirable to shorten the average maturity of the government debt (Wessel 1993). First, they argued that this would reduce the government's interest bill over time by conserving on term premia. Second, they argued that the reduction in supply would lower term premia via a portfolio balance channel, thereby depressing long-term private borrowing rates.

cutting valuable government programs in the face of temporary negative shocks.

We introduce a simplified version of the model in GHS. Consider a government with an initial accumulated debt (D) and no future expenditures that must finance itself through a combination of short-term bonds, long-term bonds, and taxes. Let S denote the fraction of the debt that is short-term and $1-S$ the fraction that is long-term.

Suppose there is a special demand that makes it cheap to issue short-term debt because short-term debt offers more of the same services as base money: tremendous liquidity and absolute safety as a store of value. It is natural to assume that the demand for these monetary services is downward sloping, so the money-like premium on short-term debt is decreasing in the total amount of short-term debt (SD). We assume that debt managers take the path of short-term interest rates (i.e., conventional monetary policy) as given, but recognize that their issuance decisions may impact the liquidity premium on short-term debt.

On the one hand, this liquidity premium makes the government want to issue more short-term debt. On the other hand, because the government must refinance this short-term debt at an uncertain future interest rate, issuing more short-term debt exposes taxpayers to refinancing risk and makes future taxes more volatile, which is costly. Specifically, a spike in interest rates would lead tax rates to jump. However, in a more general sense, such a shock to the budget might lead to a combination of tax increases and spending cuts, both of which would be painful.

Formally, assume that the liquidity premium on short-term debt is γ, that the deadweight costs of taxation are $\left(\frac{\lambda}{2}\right)\tau^2$, and that the variance of short-term interest rates is V_r. If the government finances itself by issuing fraction S of short-term debt and $(1-S)$ of long-term debt, it captures a total money premium benefit of γSD. At the same time, this raises the volatility of taxes, which have costs $\left(\frac{\lambda}{2}\right)Var[\tau]=\left(\frac{\lambda}{2}\right)D^2V_r(S-S_0)^2$, where S_0 is a small number that reflects the maturity structure that minimizes fiscal risk in isolation. Thus, the optimal fraction of short-term government debt is

$$S^* = S_0 + \frac{1}{\lambda D}\frac{\gamma}{V_r}. \tag{1-1}$$

Absent a liquidity premium on short-term debt ($\gamma = C$), the government immunizes itself against refinancing risk by opting for a long-term maturity structure, setting $S = S_0$.[8] In contrast, if there is a liquidity premium on short-term debt ($\gamma > 0$), the government issues more of it, exposing taxpayers to refinancing risk in the process. The larger the premium, the more aggressively the government relies on short-term debt. More generally, one could associate γ in equation (1-1) with other policy-relevant savings from issuing short-term (e.g., with the component of the term premium that compensates specialized bond investors for bearing greater interest rate risk).

Similarly, when short-term interest rates are less volatile (V_r is low), or when budget volatility is less costly (λ is low), the more aggressively the government seeks to capture the liquidity premium on short-term debt.[9] In the limit, if there were no cost associated with budgetary volatility, then the government should continue to shorten the maturity of the debt until the special demand for short-term debt is satiated. In this limiting case, optimal debt management is a generalization of the Friedman (1960) rule of monetary policy, which says that, absent any costs, the Federal Reserve should expand the monetary base until the demand for money is satiated.

Equation (1-3) suggests that for larger values of accumulated debt, the government should issue longer term, with both sides of the key trade-off pointing in the same direction. First, as the overall debt burden grows, the fiscal costs associated with refinancing risk or the possibility of a debt rollover

8. There is a close analogy between equation (1-3) and the classic result from the theory of portfolio choice. For an investor with a risk aversion of a, the optimal share in a risky asset whose excess returns have mean $E[rx]$ and variance $V[rx]$ is $w = E[rx]/aV[rx]$. Thus, the money premium (γ) in equation (1-3) corresponds to the expected excess return ($E[rx]$), the cost of tax volatility times the level of debt-to-GDP (λD) corresponds to the degree of risk aversion (a), and the variance of short-rate shocks (V_r) corresponds to the variance of excess returns ($V[rx]$).

9. Shortening the maturity structure has three logically distinct effects on household well-being. First, it directly raises household well-being because households derive liquidity services from holding money-like T-bills. Second, it raises the volatility of future taxes, which reduces well-being. Third, it lowers taxes today because selling T-bills that embed a liquidity premium provides the government a form of seigniorage revenue. If raising tax revenue is distortionary, but raising seigniorage revenue is not, this adds another force to those summarized in equation (1-3). However, if raising all forms of government revenue—whether through taxes or seigniorage—is distortionary, this tax-lowering consideration disappears.

crisis loom larger. Second, because the demand for liquidity services is downward sloping, the liquidity premium on short-term debt falls as D rises, further reducing the incentive to tilt toward short-term debt.

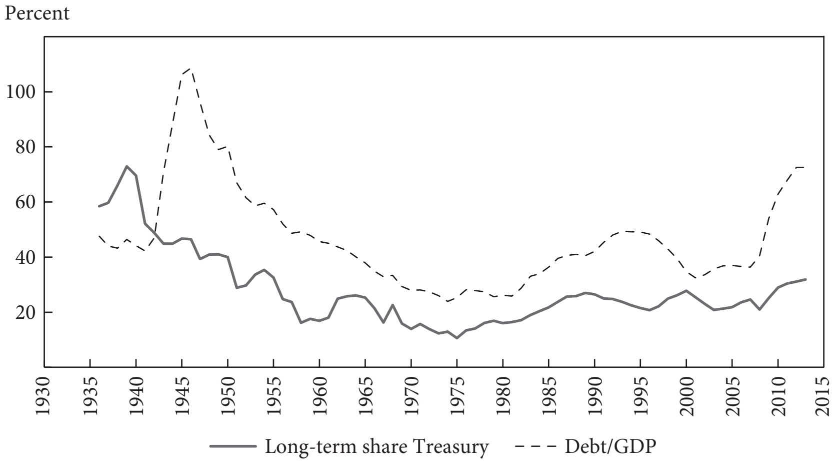
Consistent with this trade-off view, since the 1951 Treasury Accord, the United States has tended to extend the maturity of the public debt as the overall debt burden has grown. Figure 1-1 plots the fraction of outstanding debt that is long-term (defined as maturing in more than five years) against the debt-to-GDP ratio from 1952 to 2013. The two series are strongly positively correlated (correlation coefficient of 0.71). This relationship between debt maturity and debt-to-GDP is one of the most direct implications of the trade-off model.[10] It is precisely this view that explains why the Treasury lengthened the maturity of its debt beginning in 2009. The Treasury Borrowing Advisory Committee suggested in November 2009 that "the potential for inflation, higher interest rates, and roll over risk should be of material concern . . . lengthening the average maturity of debt from 53 months to 74–90 months was recommended."

How large is the special liquidity premium embedded in short-term T-bills? And why might T-bills provide greater liquidity services than longer-term notes and bonds? Krishnamurthy and Vissing-Jorgensen (2012) argue that all Treasuries have some of the same features as traditional money—namely, liquidity and absolute safety. They find that the liquidity services associated with these special attributes lead Treasuries to have significantly lower yields than they otherwise would. Their estimate of the liquidity premium on Treasuries from 1926 to 2008 is seventy-three basis points.[11] However, Krishnamurthy and Vissing-Jorgensen suggest that short- and long-term Treasuries offer very different types of safety, and so are unlikely to be perfect substitutes. T-bills provide short-term safety: the absolute stability of near-term market value. While long-term Treasuries offer long-term safety in the sense of absolute certainty of repayment, they are nevertheless subject to interim market risk. Consistent with the existence of a special demand for

10. The strong relationship between government debt maturity and debt-to-GDP is also noted by Greenwood, Hanson, and Stein (2010); Krishnamurthy and Vissing-Jorgensen (2012); and Greenwood and Vayanos (2014).

11. Krishnamurthy and Vissing-Jorgensen's estimate is based on measuring the impact of changes in Treasury supply on a variety of yield spreads. For example, they show that an increase in Treasury supply reduces the spread between long-term Treasuries and AAA-rated corporate bonds and the spread between short-term Treasury bills and highly rated commercial paper.

FIGURE 1-1. Maturity Structure of the Public Debt and Debt/GDP[a]



Sources: Data were compiled from various issues of the Monthly Statement of the Public Debt, *Treasury Bulletin*, Banking and Monetary Statistics, and *Federal Reserve Bulletin*.

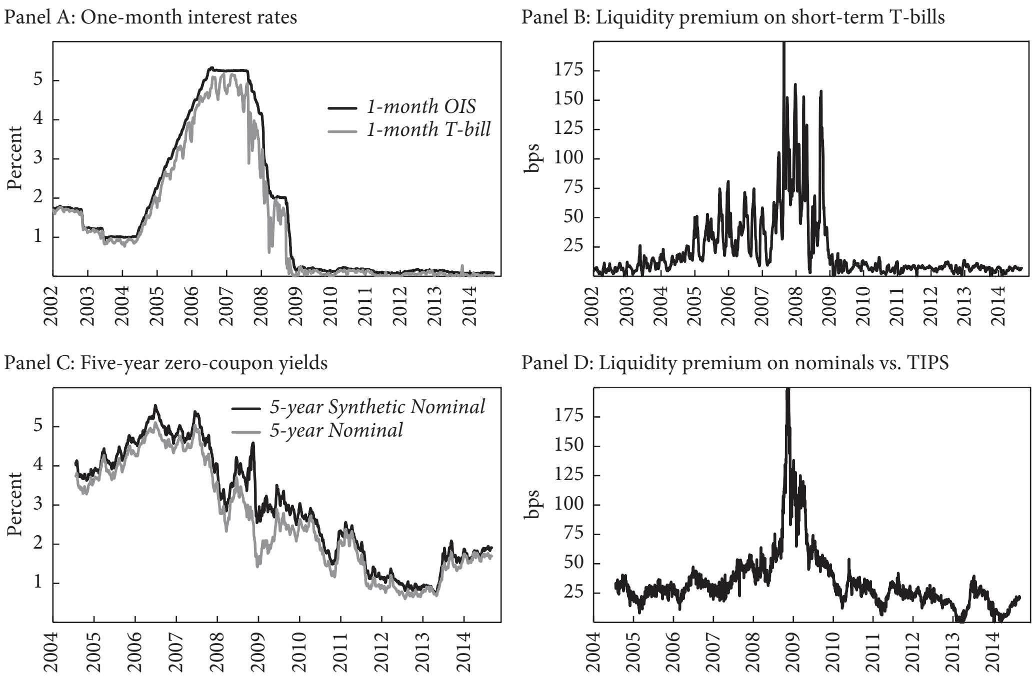
a. The solid line shows the percentage of Treasury debt that has a remaining maturity of five years or more. The dashed line shows the debt-to-GDP ratio.

short-term safety, the yields on short-term T-bills are often quite low relative to those on longer-term notes and bonds (Amihud and Mendelson 1991; Duffee 1996). GHS confirm this by comparing actual T-bill yields with "fitted yields," where the fitted yield is an estimate of what the yields on T-bills should be, based on the shape of the rest of the yield curve. Their analysis suggests that on average, from 1983 to 2009 four-week bills had yields roughly forty basis points *below* their fitted values based on longer-term Treasuries.

Figure 1-2 illustrates the special money-like premium on very short-term Treasury bills. Panel A plots the yield on one-month T-bills versus the one-month overnight index swap (OIS) rate, which is a good proxy for the default-free short-term rate that does not benefit from these special liquidity premia.[12]

12. The OIS rate is unlikely to be affected by default risk since it is based on the expected overnight Federal funds rate. And it is largely free of any convenience premium since it is not a rate at which a money-market investor can invest principal (i.e., a swap is not a stable-value store of value in the same way as a T-bill or financial CP).

FIGURE 1-2. Estimates of Liquidity Premia on Treasuries



Sources: Federal Reserve Economic Database; Bloomberg; Zero-coupon nominal Treasury and TIPS yields are from Gurkaynak, Sack, and Wright (2007, 2010).

Note: Panel A plots the yield on one-month Treasury bills from the Federal Reserve Economic Database (FRED) and the one-month overnight index swap (OIS) rate from Bloomberg. Panel B plots the difference between the one-month OIS rate and the one-month T-bill rate. Panel C plots the yield on a *synthetic* five-year zero-coupon nominal Treasury—computed as the sum of the five-year TIPS yield at the five-year inflation swap yield—versus the actual five-year zero-coupon yield for nominal Treasuries. Panel D plots the difference between the synthetic nominal yield and the actual nominal yield. In all four panels, we show the weekly moving averages of daily data.

Panel B plots the spread between the one-month OIS rate and the one-month T-bill rate. This spread reflects the special money-like liquidity premium on T-bills. GHS show that these convenience premia are particularly pronounced for very short-term bills such as those maturing in less than a quarter or a month.

There is strong evidence that shifts in these liquidity premia are driven by shifts in the demand and supply of money-like assets. Specifically, Krishnamurthy and Vissing-Jorgensen (2012) and GHS find that shifts in T-bill supply due to movements in the debt-to-GDP ratio can explain much of the low-frequency variation in the liquidity premia on T-bills. Nagel (2014) argues that shifts in the demand for money-like debt associated with changes in the level of short-term nominal interest rates explain much of the business-cycle frequency variation in these premia. Specifically, demand for money-like debt and hence liquidity premia are high when short-term interest rates are high. This pattern is clearly evident even in the short time-series shown in Figure 1-2.[13] At higher frequencies, the variation in these spreads is explained as seasonal fluctuations in T-bill supply (GHS) and week-to-week shifts in the institutional demand for money market investments, as well as flight-to-quality episodes (Sunderam 2014).

How large are the fiscal risk costs associated with issuing more short-term debt? In the GHS model, fiscal costs coming from the deadweight costs of taxation are $\left(\frac{\lambda}{2}\right)\tau^2$, so the marginal deadweight cost is $\lambda\tau$. A conservative upper bound on the marginal deadweight cost is 0.5 (Chetty 2012). Assuming a tax rate of roughly 25 percent, this implies an upper bound of $\lambda = z$. Thus, the costs of distortionary taxation are no greater than $E[\tau]^2 = (E[\tau])^2 + Var[\tau]$. Assuming $E[\tau] = 25$ percent, this implies that $E[\tau]^2 = 6.25$ percent. However, the component of $Var[\tau]$ driven by fluctuations in interest rates is likely an order of magnitude smaller. In other words, plausible estimates of the welfare costs from the failure to smooth taxes over time are tiny.

Although emphasized by GHS in their formal model, thinking of fiscal risk as solely the distortionary costs of taxation is too limited. Consider the following back-of-the-envelope calculation. Suppose all the debt is short-term

13. Nagel's (2014) argument is that short-term debt is a partial substitute for traditional forms of money such as currency and checking deposits. Since traditional money pays little or no interest, the nominal interest rate is the opportunity cost of holding money. Similarly, the liquidity premium—that is, the difference between the yield on an illiquid short-term deposit and the yield on liquid short-term debt—is the opportunity cost of holding money-like short-term debt. All else equal, this suggests that savers will want to hold less traditional money and more money-like short-term debt when short-term interest rates rise. Consistent with this view, savings tend to flow out of non-interest-bearing checking accounts and into money-market funds when short-term interest rates are high.

and is refinanced once each year. Then, at the current debt-to-GDP ratio of 70 percent, a 1 percentage point increase in short-term real interest rates raises the ratio of interest expense to GDP by 0.70 percent, or $120 billion, based on 2014Q2 GDP of $17.3 trillion (at an annual rate). This is not a trivial shock to the federal budget, exceeding the projected 2014 outlays of the Departments of Homeland Security ($50 billion), Education ($65 billion), Labor ($75 billion), and Transportation ($80 billion). An unlikely 5 percentage point increase in short-term real rates would raise interest costs by 3.5 percent of GDP, or by $600 billion, exceeding the projected 2014 outlays for the Department of Defense ($595 billion). Calculations of this sort have often been used to motivate a strategy of extending the maturity of the debt (Cochrane, chapter 3 of this book).

Common sense suggests that the government might be willing to pay some insurance premium to avoid such scenarios. For instance, suppose we pay an additional 0.20 percent in interest on the debt to keep the interest expense smooth. In dollar terms, an annual premium of $25 billion (= $17.3 trillion × 70% × 0.20%) could insure against potential budgetary shocks of the magnitude described.

However, even if the government is willing to pay *some* insurance premium to reduce fiscal risk, there are two important reasons to think that the government may be able to take advantage of the large liquidity premium on short-term bills without incurring much additional risk. First, substituting one-month T-bills, for which liquidity premia are very high, for six-month T-bills may allow the government to capture the liquidity premium without significantly increasing overall budget volatility. This is because both one-month and six-month bills are similar from the perspective of interest rate risk.

Second, issuing short-term debt may be a natural hedge for fiscal shocks to the primary budget deficit. Specifically, the only source of fiscal risk in the baseline GHS model is due to uncertainty about the path of future short-term interest rates. However, debt managers also deal with volatility from the budgeting process that increases the overall debt burden. Consider the case where government debt managers are uncertain about both the path of future short-term interest rates as well as future primary fiscal deficits. In this regard, the existence of automatic stabilizers—the fact that government tax proceeds tend to fall and transfer payments tend to rise in recessions—suggests that primary fiscal deficits will tend to be high during recessions when short-term interest rates are low. This adds an additional fiscal hedging motive for issuing short-term debt. The idea is that the cost of refinancing short-term debt tends to be low in states when primary deficits are high. Specifically, adapting the baseline GHS model, it is straightforward to show that the optimal fraction of short-term government debt is

$$S^* = S_0 + \frac{1}{\lambda D}\frac{\gamma}{V_r} - \frac{\beta_{G,r}}{D}, \tag{1-2}$$

where $\beta_{G,r}$ is the coefficient from a regression of unexpected future government deficits (G) on short-term real rates (r).[14] Since we expect $\beta_{G,r} < 0$, this fiscal hedging motive should push the government to adopt even more short-term debt maturity structure.

Debt Management and Aggregate Demand

Policymakers have tended to see monetary policy as distinct from debt management. However, the clean lines of demarcation between these branches of policy have been blurred since 2008. The Fed's quantitative easing policies, which have swapped long-term Treasuries for short-term interest-bearing reserves, have shortened the maturity of the net consolidated debt held by the public.[15] Fed officials have argued that shortening the maturity of the consolidated public debt should lower the general level of long-term interest rates relative to short-term rates, stimulating long-term investment and consumption. In other words, the maturity structure of the public debt may be a tool of aggregate demand management. This may be one of the only tools available to the Fed for combating high unemployment and the threat of price deflation once nominal interest rates hit zero.

Holding fixed the path of short-term interest rates and the total size of the debt, how can the average maturity of government debt affect long-term

14. Equation (1-4) follows from the observation that with an unknown future deficit of G, we have $\left(\frac{\lambda}{2}\right)Var[\tau] = \left(\frac{\lambda}{2}\right)[V_r D^2 (S-S_0)^2 + V_G + 2D(S-S_0)C_{G,r}]$, where $V_G = Var[G]$ and $C_{G,r} = Cov[G, r]$.

15. Technically, QE can be thought of as combination of a "conventional monetary easing," in which the Fed expands the supply of bank reserves by purchasing T-bills, and an Operation Twist, in which the Fed sells T-bills and buys long-term Treasuries. The conventional easing component has no effect at the zero lower bound, so the entire effect must come from the Operation Twist component (Woodford 2012).

interest rates? The idea is that a reduction in government debt maturity lowers the amount of interest rate risk that fixed-income investors have to bear, leading to a decline in the term premium—that is, the difference in expected returns between long- and short-term bonds—due to a Tobin-style portfolio balance effect (Tobin 1958). Thus, the relevant summary statistic for such portfolio balance policies would be the weighted average (or total dollar) duration held by private, fixed-income investors.[16]

The strong evidence that debt management policies do impact term premia suggests that interest rate risk that is borne by investors directly through bond markets looms larger than interest rate risk that is borne indirectly by taxpayers.[17] As noted, the most natural explanation for this non-Ricardian result is that the marginal investor in bonds is a specialized, fixed-income investor who is far more heavily exposed to interest rate risk than the typical taxpayer. Thus, a reduction in the duration of government debt only succeeds in lowering term premia because it asks the typical taxpayer to bear a tiny bit more interest rate risk so that the marginal bond investor can bear much less risk (Woodford 2012; Greenwood and Vayanos 2014; Hanson 2014).

Debt Management as a Financial Regulatory Tool

Financial regulation and debt management have historically been seen as separate spheres of policy. However, the desire to promote a stable financial system may push the government further toward a shorter-term maturity structure (GHS).

To understand the argument, note that the government is not the only entity that can create riskless money-like short-term debt. Specifically, Gorton (2010), Pozsar (2011, 2012), Gorton and Metrick (2012), Stein (2012), and

16. In the formulation of this idea by Vayanos and Vila (2009) and Greenwood and Vayanos (2014), term premia are proportional to the product of interest rate risk and dollar duration, scaled by the risk tolerance of bond investors.

17. See Greenwood and Vayanos (2014) for comprehensive evidence from the postwar era. See also Gagnon and others (2011), Krishnamurthy and Vissing-Jorgensen (2011), Jarrow and Li (2012), and Li and Wei (2013) for appraisals of the Fed's large-scale asset purchase programs. See Bernanke, Reinhart, and Sack (2004); Greenwood and Vayanos (2010); and Swanson (2011) for event study evidence predating the LSAPS. Relatedly, Hanson (2014) and Malkhozov and others (2014) provide strong evidence that shifts in the duration of U.S. mortgage-backed securities move bond term premia, even though they would have no effect if markets were frictionless.

Krishnamurthy and Vissing-Jorgensen (2013) argue that when financial intermediaries issue money-like short-term debt that is collateralized by long-term risky assets, they are engaged in liquidity creation. In this way, they capture some of the same liquidity premium as the Treasury does when it issues T-bills. While some amount of private liquidity transformation is desirable, the incentives for private liquidity creation are likely excessive because individual intermediaries do not take into account the full financial stability costs that are generated by their use of short-term funding. Put differently, liquidity transformation generates negative externalities, so government policies that work to reduce intermediaries' overreliance on short-term funding may be desirable. And private liquidity transformation may be hard to regulate, particularly if it is done by the shadow banking sector.

What role can the government play through debt management? The government may "crowd out" some private sector short-term issuance by issuing more of its own short-term debt. An expansion in the supply of Treasury bills would lower the premium on short-term money-like debt and reduce the temptation for private intermediaries to issue short.[18] Of course, this policy response is not without cost since it generates additional fiscal risk. Thus, it is not optimal for the government to issue so much short-term debt as to completely counteract intermediaries' tendency to overrely on short-term funding. Said differently, the government should keep shortening its maturity as long as it has a comparative advantage over the private sector in the production of money-like short-term debt.

Another way to address the financial stability externalities associated with private liquidity transformation would be to regulate short-term private liabilities (Ricks 2013; Cochrane 2014). Private liquidity transformation could be directly controlled using a regulatory cap, as under the Basel III bank liquidity regulations, or by taxing short-term issuance directly, as suggested by Kashyap and Stein (2012) and Stein (2012). However, to the extent that direct regulation simply pushes liquidity transformation into the unregulated shadows, there will be a complementary role for a debt management policy. Specifically, by influencing the liquidity premium on short-term debt, debt management can influence private sector incentives to engage in liquidity transformation, reaching into corners of the financial markets that lie beyond

18. See GHS, Krishnamurthy and Vissing-Jorgensen (2013), Carlson and others (2014), and Sunderam (2014) for evidence that a rise in short-term government debt crowds out short-term debt issuance by financial intermediaries.

the grasp of regulators. In other words, the advantage of debt management over direct regulation is that it “gets in all the cracks” (Stein 2013).

GHS argue that this crowding-out motive for issuing short-term T-bills may be of the same order of magnitude as the direct motive for producing debt with the liquidity services highlighted previously. Thus, when weighed against the fiscal risk costs of issuing additional short-term debt, this financial stability benefit may be sufficient to meaningfully shorten the optimal maturity structure of the government debt.

Quantitative Assessment and Debt Counterfactuals

The analysis thus far suggests that the forces in favor of short-term debt appear to be larger than conventionally thought. Still, this does not provide much quantitative guidance as to whether the weighted average maturity of the debt should be 12 months, 60 months, or 120 months. In this section, we take a simple approach to this question by describing the results of a counterfactual exercise in which we suppose that the government had relied much more heavily on short-term debt following the 1951 Accord.

We focus on the extreme case in which the government had financed the debt using three-month T-bills, meaning that the entire outstanding debt would be refinanced four times per year. We start by noting that the change in the debt equals the primary deficit (outlays and net transfer payments minus total tax revenue) plus interest paid:

$$\text{Debt}_t = \text{Debt}_{t-1} + \text{PrimDef}_t + \text{Interest}_t, \tag{1-3}$$

where Debt_t refers to the public debt held at the end of the fiscal year t (including debt held by the Federal Reserve), PrimDef_t refers to the primary deficit, and Interest_t refers to interest paid, including coupons on notes and bonds and imputed interest on Treasury bills that do not pay a coupon. We obtain Debt_t and Interest_t from the Office of Management and Budget, and use this data to back out the primary deficit according to equation (1-3). Our data start in June 30, 1951 (start of the 1952 fiscal year), capturing the start of the post-Accord period.

Figure 1-3 shows the time-series of average interest payments, expressed as a percentage of GDP. Interest payments average 1.8 percent of GDP per year, reflecting an average effective nominal interest rate paid of 4.97 percent.

$\frac{\text{Interest}}{\text{GDP}}$ is quite smooth over time, with a standard deviation of only 0.72 percent. In part, this reflects the average long-term nature of the debt and the fact that debt-to-GDP has been moderate over much of this 1952–2013 sample.

Our counterfactual exercise assumes a debt management strategy of continuously rolling over three-month Treasury bills. We assume that the actual short-term interest rates that have prevailed since 1952 would have also prevailed under this counterfactual strategy. In doing so, we ignore the fact that the path of short-term interest rates would likely have been slightly different due to the deviations from Ricardian equivalence. For instance, in the extreme, financing the government entirely with short-term bills might make the government susceptible to bank-run-like outcomes, which could have a significant impact on interest rates.

We compute the effective annual interest rate under this counterfactual debt management policy, $R^{\text{Counterfactual}}$, by compounding three-month Treasury bill rates.[19] We then compute counterfactual interest payments according to

$$\text{Interest}_t^{\text{Counterfactual}} = \text{Debt}_{t-1}^{\text{Counterfactual}} \times R_t^{\text{Counterfactual}}. \quad (1\text{-}4)$$

Modifying equation (1-4) allows us to compute a counterfactual evolution of the debt stock as

$$\text{Debt}_t^{\text{Counterfactual}} = \text{Debt}_{t-1}^{\text{Counterfactual}} + \text{PrimDef}_t + \text{Interest}_t^{\text{Counterfactual}}. \quad (1\text{-}5)$$

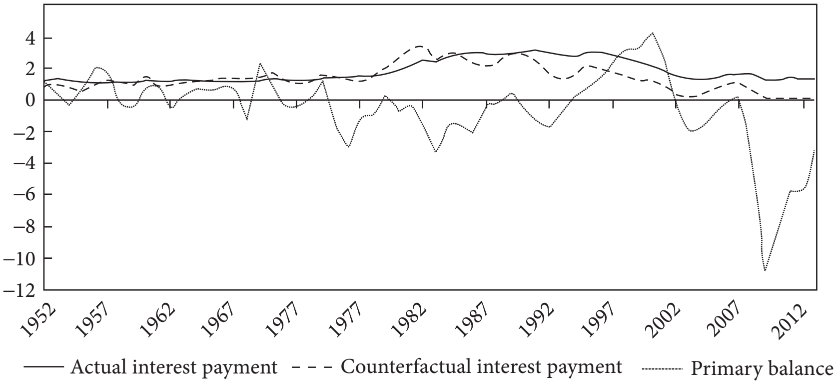
Thus, starting with the actual debt outstanding at the end of 1951, we can construct a counterfactual path for $\frac{\text{Interest}}{\text{GDP}}$ and $\frac{\text{Debt}}{\text{GDP}}$, taking as given the government's realized primary deficits.

19. We obtain month-end data on three-month T-bill rates from the Federal Reserve Bank of St. Louis's FRED database. To compute the interest paid on a fiscal year basis (the federal government's fiscal year runs from October 1 to September 30), we compute the effective annual rate as $R^{\text{Counterfactual}} = [(1+r_{(\text{Sept.})})(1+r_{(\text{Dec.})}) \times (1+r_{(\text{March})})(1+r_{(\text{June})})]^{\frac{1}{4}} - 1$, where the subscripts on the three-month T-bill rate indicate the relevant month-end.

FIGURE 1-3. Debt and Deficits under Counterfactual Debt Management Plans

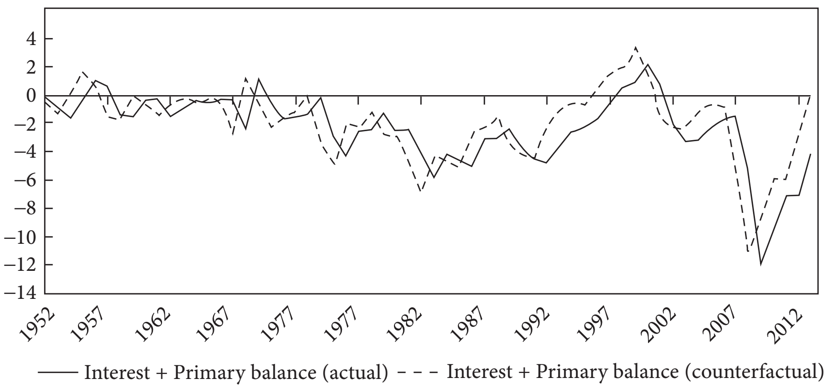
Panel A: Actual and counterfactual interest payments and primary balance

Percent GDP



Panel B: Total surplus in actual data and counterfactual

Percent GDP



Panel C: Debt and counterfactual debt burden

Percent GDP

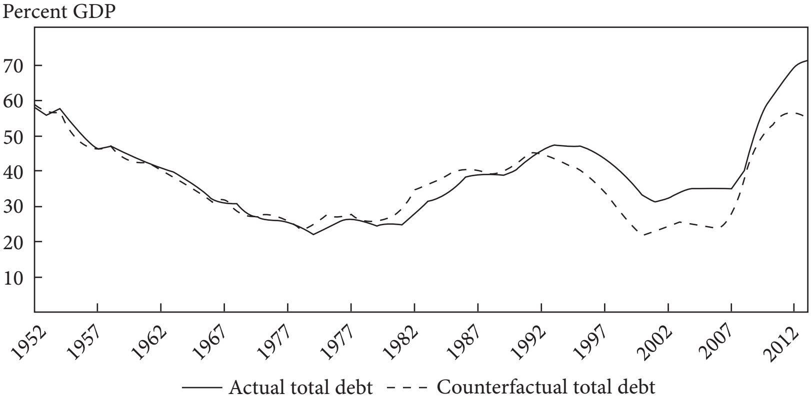


FIGURE 1-3. *Continued*

Sources: Office of Management and Budget; Federal Reserve Economic Database; Authors' calculations.

Note: The counterfactual exercise measures the path of deficits and debt supposing that the U.S. Treasury had financed itself using rolling three-month Treasury bills starting in 1952. We use the identity, $\text{Debt}_t = \text{Debt}_{t-1} + \text{PrimDef}_t + \text{Interest}_t$, and data on debt and net interest payments to back out primary deficits. Debt held by the public is from the Office of Management and Budget (OMB); net interest expense is also from the OMB. In the counterfactual case, starting in September 1952, we compute net interest as the compounded interest from rolling over three-month Treasury bills over the government fiscal year. Panel A shows actual and counterfactual interest payments, scaled by GDP. For purposes of comparison, it also shows the path of primary surpluses and deficits (surpluses carry a positive sign). In Panel B we combined interest payments and the primary balance to show the combined total surplus, in both the actual data and the counterfactual. In Panel C we show the debt burden, as a percentage of GDP, in the realized and counterfactual cases.

Figure 1-3 shows that issuing short-term debt results in higher volatility of interest payments. The volatility of $\frac{\text{Interest}}{\text{GDP}}$ is 0.84 percent under the counterfactual strategy, compared to 0.72 percent under the actual strategy. How should we evaluate these numbers? Panel A in figure 1-3 shows that the volatility of $\frac{\text{Interest}}{\text{GDP}}$—whether in the actual or counterfactual case—is quite small compared to the volatility in $\frac{\text{PrimDef}}{\text{GDP}}$, which has an annual time-series volatility of 2.54 percent. But a simple comparison of the time-series volatilities under different financing regimes does not suffice, because the net increase in the debt stock is the *sum* of interest payments and the primary deficit, meaning that a short-term financing policy can serve as a hedge against primary deficits. The simple explanation is that the primary deficit tends to be larger when the economy is performing poorly and is associated with low or declining short-term interest rates.

How much did the government save in this counterfactual financing strategy? Our calculations suggest the government would have saved 0.38 percentage points of GDP per year. Panel C in figure 1-3 shows that the cumulative interest savings would have meaningfully lowered the debt stock over time. By the end of the sample, the public debt was 71.3 percent of GDP, whereas in the counterfactual case, it was only 54.8 percent.

What this makes clear is that *ex post*, the government would have been better off financing its debt over the short-term. To be clear, we are not suggesting that we should use this exercise as an estimate of the interest cost savings that would be obtained by shortening the maturity of the debt going forward. For one thing, in the 1980s, the United States experienced a decline in inflation that was unexpected by market participants, a situation unlikely to be repeated. Notwithstanding, figure 1-3 shows estimated *ex ante* term premia as estimated by Kim and Wright (2005), which averaged forty-five basis points per annum on five-year zero-coupon debt from 1989 to 2013. Second, the logic of our model suggests that the average savings we computed overstates the welfare benefits from adopting a shorter debt maturity profile. The reason is that some of the term premium on long-term bond is surely compensation for risk in the traditional frictionless, asset-pricing sense. However, the government is not making households any better off by issuing short-term to “economize” on this risk premium since this necessarily increases the interest rate exposure of household’s tax liabilities. Only the component of the term premium that is due to the T-bills providing higher liquidity convenience services or stemming from segmented bond markets should count from a welfare perspective.[20]

In summary, the main messages we take from these counterfactual exercises are (1) that the additional budgetary volatility incurred by shifting the government debt into short-term securities is less than is commonly supposed, and (2) that doing this would have allowed the government to capture liquidity premia on an ongoing basis.

20. We have repeated this counterfactual exercise in real terms, meaning that we compute the real value of the debt and the real interest (both as it happened and in the counterfactual case in which the government rolled over short-term debt). Expressed in real terms, the “interest burden” of the debt reflects a combination of shocks to real interest rates and inflation. Real interest payments are more volatile than nominal interest payments. The standard deviation in the counterfactual case is 1.97 percent, more than twice the standard deviation of actual interest paid (0.81 percent). Both series are still less volatile than real primary deficits, which have a standard deviation of 2.52 percent. The correlation between the real actual interest payment and the real primary deficit is not significantly different from zero. In the counterfactual case, however, the correlation between effective real interest payments and the primary deficit is −0.39. This can be compared to the −0.26 correlation between nominal interest payments and the nominal primary deficit.

Debt Management beyond Maturity Structure

The framework for debt management that we have developed here can be extended to accommodate a host of issues beyond the question of the optimal maturity structure. We briefly discuss these extensions here.

The Choice of Nominal versus Inflation-Indexed Debt

Consider for example the choice between long-term nominal and inflation-indexed debt. To do so, we need to distinguish between shocks to real interest rates and the rate of inflation. The government can now issue short-term bonds (automatically inflation-indexed since we assume that uncertainty about inflation is minimal at short horizons), long-term nominal bonds, and long-term inflation-indexed bonds.

Suppose that government debt managers take the path of inflation and short-term real rates as given. If short-term real interest rates tend to be high when inflation is high—as one would expect if the Federal Reserve follows a standard Taylor rule—then short-term debt and long-term nominal debt will be complementary from a fiscal risk perspective. Suppose, for example, that inflation is low so that the real tax burden needed to service long-term nominal debt is high. Since short-term real rates are likely to be low in such a state, this makes short-term debt a good hedge for long-term nominal debt.

Beyond these risk management considerations, there is strong evidence that long-term nominal Treasuries embed a significant liquidity premium relative to long-term Treasury inflation-protected securities (TIPS) (Campbell, Shiller, and Viceira 2009; Fleckenstein, Longstaff, and Lustig 2014; Pflueger and Viceira 2013).

How large is the premium on nominal versus inflation-indexed debt? Fleckenstein, Longstaff, and Lustig (2014) estimate an average liquidity premium of roughly fifty-five basis points on nominal Treasuries compared to TIPS from 2004 to 2009.[21] Pflueger and Viceira (2013) find similar magnitudes for the United States, as well as from inflation-indexed debt in the United Kingdom. Both papers argue that this is not simply the capitalized value of

21. Fleckenstein, Longstaff, and Lustig (2014) show that the price of nominal Treasury bonds exceeds the price of a portfolio consisting of a maturity-matched TIPS and an inflation swap that replicates the cash flows on the nominal Treasury. This implies that the yields on nominal Treasuries are lower because of a liquidity premium.

future bid-ask spreads or other transaction costs. Instead, it appears to reflect a special liquidity premium.

In figure 1-2, we show an estimate of the liquidity premium on nominal bonds from 2004 to 2014. Specifically, our estimate of the nominal liquidity premium is the yield on five-year TIPS, plus the yield on a five-year inflation swap, minus the yield on a five-year nominal Treasury note. Since an investor can generate the exact same financial cash flows by buying a five-year nominal Treasury or by buying a five-year TIPS note and entering into an inflation swap (receiving the swap yield and paying realized inflation), this spread should be zero if investors derived the same liquidity services from holding nominal and inflation-indexed debt. By contrast, this spread will be positive if investors derive greater liquidity services from holding nominal debt. As shown in panel D of figure 1-2, the liquidity premium on nominal Treasuries versus TIPS spiked during the financial crisis and has averaged roughly 35 bps from 2004 to 2014.

Formally, let S be the fraction of debt that is short-term and N be the fraction of debt that is long-term and nominal. The remaining $1-S-N$ of the debt will be long-term and inflation-indexed. Let $1-S-N$ be the liquidity premium on long-term nominal debt and $\gamma \geq 0$ be the premium on short-term debt, both measured relative to long-term TIPS. Extending the logic in GHS, the optimal debt portfolio is given by

$$S=\frac{1}{2}+\frac{1}{\lambda D}\frac{\gamma}{V_r}\frac{1}{1-R^2_{r,\pi}}+\frac{1}{\lambda D}\frac{\theta}{V_r}\frac{\beta_{r,\pi}}{1-R^2_{r,\pi}} \quad \text{(1-6a)}$$

$$N=\frac{1}{\lambda D}\frac{\theta}{V_\pi}\frac{1}{1-R^2_{r,\pi}}+\frac{1}{\lambda D}\frac{\gamma}{V_\pi}\frac{\beta_{\pi,r}}{1-R^2_{r,\pi}}, \quad \text{(1-6b)}$$

where V_π is the variance of inflation, $\beta_{r,\pi}$ is the coefficient from a regression of short-term real rates on inflation, $\beta_{\pi,r}$ is the coefficient from the reverse regression of inflation on real rates, and $R^2_{r,\pi}$ is the goodness of fit from these regressions.[22]

22. Equations (1-6a) and (1-6b) follow from the observation that with an unknown future inflation of π, we have $\left(\frac{\lambda}{2}\right)Var[\tau]=\left(\frac{\lambda}{2}\right)D^2[V_r(S-S_0)^2+V_\pi N^2-2(S-S_0)NC_{\pi,r}]$, where $V_\pi=Var[\pi]$ and $C_{\pi,r}=Cov[\pi,r]$.

To interpret equations (1-6a) and (1-6b), note that if $\gamma = \theta = 0$, the government should not issue long-term nominal debt since doing so only raises the variability of the tax burden in real terms. This is consistent with Summers (1997), who summarized the rationale for introducing TIPS in 1997 as: "We were attracted to them by their ability to stabilize debt payments by the government."

Next, if shocks to short-term real rates and inflation are uncorrelated (so $\beta_{r,\pi} = \beta_{\pi,r} = R^2_{r,\pi} = 0$), the optimal short-term share S depends on the premium on short-term debt (γ) and is limited by the volatility of short-term real rates (V_r), and the optimal share of long-term nominal debt depends on the premium on nominal debt (θ) and is limited by the volatility of inflation (V_r). Finally, in the plausible case where inflation and real rates are positively correlated, equations (1-6a) and (1-6b) capture the complementarity of short and nominal debt from a fiscal risk perspective. For instance, the tendency to issue short and nominal debt is largest when the R^2 from a regression of real rates on inflation is high. In this case, short-term debt is a good hedge for nominal debt and vice versa, so the government can be quite aggressive in catering to the special liquidity demands for short-term debt and long-term nominal debt without incurring significant tax-smoothing costs.

We have assumed that government debt managers take the inflation process as given. While this strikes us as an accurate description of the situation today and in most of the postwar era, this may not be true in situations where the debt burden becomes extreme. By relying on nominal debt, the government may be able to smooth the real tax burden by engineering a large inflation following the accumulation of significant fiscal deficits. This safety valve may make long-term nominal debt more desirable than inflation-indexed debt. Looking across history, Reinhart and Sbrancia (2011) and Piketty (2014) describe how the accumulation of massive government deficits during major wars has often been followed by inflationary episodes that have significantly reduced the debt burden in real terms.[23] Ferguson, Schaab, and Schularick

23. This regularity is linked to the fiscal theory of the price level (Leeper 1991; Sims 1994; Woodford 1995; Cochrane 2001). This theory says that if a government has an unsustainable fiscal policy, such that it will not be able to repay its debts out of future primary surpluses, then it will choose to inflate away the debt. Thus, the current nominal price level is pinned down by the current level of nominal

(2014) suggest that periods of central bank balance sheet growth have been undone mostly via inflation rather than nominal declines.

Additional Considerations

Our framework can easily be extended to incorporate additional debt management considerations. Two additional considerations stand out.

First, Treasury officials routinely argue that debt management policies play a role in promoting the infrastructure and broader efficiency of U.S. capital markets. Specifically, it is arguably useful to investors in other fixed-income assets—including corporate bonds, municipal bonds, mortgage-backed securities, and asset-backed securities—to have liquid benchmark Treasury securities with maturities of, say, two, five, ten, and thirty years. Such transparent benchmarks for the risk-free rate may facilitate new issue pricing in other markets and may also be useful for hedging (Fleming 2000). The desire to maintain liquid benchmark Treasury issues became an increasing concern in the late 1990s when the government ran a series of large fiscal surpluses and was expected to significantly pay down the debt over time. Indeed, one of the major rationales for the Treasury's 2000–2001 buyback operations was to maintain large five-, ten-, and thirty-year on-the-run benchmark issues in an era of declining overall debt supply (Sachs 1999; Fleming 2000). Several sovereigns, including Chile, have opted to maintain a liquid benchmark yield curve even when total debt was near zero.[24]

Promoting financial market infrastructure by issuing liquid benchmark securities can be viewed as a kind of nonpecuniary service generated by government debt. However, some of the "benchmark" value of Treasuries has a public good character and thus is unlikely to be fully captured in the market prices.

Second, we have discussed the liquidity premia on short-term government debt and nominal government debt and explained why the government should cater to these special demands. However, there may be other

government debt and the expected value of future real primary surpluses. In this way, fiscal discipline is a critical necessary condition for price stability.

24. Since 2003, the Chilean government has regularly issued domestic bonds despite being in a net creditor position. The stated aim of these issuances is to enhance bond market liquidity in Chile.

government securities that embed significant liquidity premia. For example, "on-the-run" Treasuries typically embed a liquidity premium relative to "off-the-run" issues with nearly identical cash flows (Warga 1992; Krishnamurthy 2002; Vayanos and Weill 2008). This makes them especially useful for risk management and hedging.

Debt-buyback operations, such as those undertaken from 2000 to 2001, can be understood as a case where issuing securities with a greater liquidity premium imposes little, if any, additional fiscal risk for the government. Specifically, if there is a special liquidity premium on "on the run" Treasury securities (e.g., the on-the-run thirty-year bond), then the government can engage in a form of liquidity creation that entails little, if any, fiscal risk by issuing thirty-year bonds that command a large convenience premium and repurchasing these bonds when they become twenty-nine-year bonds with a much smaller convenience premium (Garbade and Rutherford 2007).

Summary

Optimal debt management hinges on trade-offs between four potentially competing objectives: (1) financing the government at least cost by catering to liquidity premia and economizing on term premia; (2) limiting fiscal risk, particularly that associated with short-term financing; (3) managing aggregate demand by using the maturity of government debt to influence long-term interest rates; and (4) promoting financial stability by issuing enough short-term government debt to counteract the financial system's tendency toward excessive liquidity transformation.

Many of these forces can be readily quantified. For example, researchers have developed a variety of methods to estimate liquidity premia and term premia. And the recent experience of the Federal Reserve and other central banks with quantitative easing policies have provided researchers with an increasing amount of data to assess the aggregate demand effects of debt management policy.

However, some of these forces are more difficult to quantify and require further study. For example, researchers have only begun to examine the financial stability benefits that may accrue when the government issues more short-term debt. Similarly, while it is possible to project the budgetary consequences of different debt management policies, it is less clear how to assess the ultimate cost of budgetary volatility.