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公債負担の再考—流れに身を任せる？

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【要旨】

本論文は公的債務の実証的なフローの指標として、DaaF を提唱し、従来の指標である公債のＧＤＰ比と比較する。

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1. Introduction

In recent years the sustainability of the US Treasury debt has come to the forefront of both political and economic analysis. Many observers of the US economy have expressed concerns about rising debt levels and the adverse effects this increase may have on future economic growth. An important element of this debate is the choice of an appropriate macroeconomic indicator of a country's ability to repay its debt. A widely used measure in both academic as well as mainstream settings is the concept of the "debt-to-GDP" ratio which is obtained by dividing the national debt, a stock, with the gross domestic product (GDP, henceforth), a flow. In the literature it is commonplace to associate a higher value for this ratio with negative growth prospects for an economy (Cecchetti et al., 2012; Bohn, 1998).

An important issue in interpreting the debt-to-GDP ratio is the differing units of the variables used in computing the ratio. Taking the US as an example, the national debt is measured in dollars at a point in time whereas GDP is measured in dollars per unit of time. As a result the ratio itself has units of the frequency over which the GDP is measured. For instance, at an annual frequency such a measure has the interpretation of the number of years it would take a country to pay its debt under an unlikely scenario of allocating the entire GDP towards the debt repayment. In fact, the choice of a year as a time metric for debt repayment makes little sense and is inherently arbitrary. For instance, using annual data the US debt-to-GDP ratio stood at 73.8 percent at the end of 2013.[1] If instead of using an annual GDP measure we were to use data compiled quarterly then the debt-to-

[1] In this case we are only considering the marketable debt issued by the Treasury (`http://research.stlouisfed.org/fred2/data/FYGFGDQ188S.txt`)

GDP ratio would be four times as large. This obviously does not mean that the US is any more burdened by debt than when using an annual measure.[2] The debt-to-GDP indicator does offer some insight on the potential sustainability of a nation's deficits, and is useful in other contexts due to its easy calculation and historical availability. However, such a measure ignores an important aspect of the sovereign debt management: a country's ability to manage the terms of repayment by influencing the maturity of its debt. Theoretically, a government facing high debt levels may either increase or decrease the maturity of its debt (Alesina et al., 1990; Missale and Blanchard, 1994; Giavazzi and Pagano, 1990). The nature of this relationship, hence is an empirical question. Many studies have found that the relationship between maturity and debt-to-GDP ratio is generally positive for the US (De Haan et al., 1995). The US Treasury Department has been able to extend the maturity of its debt even though the recent financial crisis led to a rapid accumulation of debt. Between late 2008 and the end of 2013, the Treasury extended the average maturity of outstanding marketable securities by approximately 37 percent.[3] We argue that a country that is able to extend the maturity of its debt can spread out the future payments toward its debt across much longer periods. Hence, the a measure of a country's payment capacity that ignores this channel will be a poor indicator of the debt burden.

We aim to broaden the discussion on the macroeconomic implications of sovereign debt in two dimensions. First, we argue that an appropriate analysis of debt burden should account for possible changes in the duration of debt over time. Using the detailed historical data

[2]Shiller (2011) makes this argument more explicitly in `http://www.social-europe.eu/2011/07/debt-and-delusion/`.

[3]`http://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Documents/Quarterly\%20Data\%20Release.xls`.

on bond issues provided by the US Treasury, we compute duration and use it to compile a monthly time series measuring debt-as-a-flow ("DaaF"). The DaaF measure takes total debt divided by the total duration (measured in years) to estimate an annual burden of debt as though it were evenly distributed over each year. Second, we recommend using this flow measure of debt to capture debt burden instead of the conventionally used debt-to-GDP ratio. DaaF divided by GDP gives a unit-less ratio that represents a closer approximation to the percentage of income that would need to be allocated to debt repayment. Unlike the debt-to-GDP ratio, our measure of debt burden does not require assigning an arbitrary unit of time for repayment of national debt and applies at any frequency. We believe that such a measure is more appropriate for gauging the payment capacity of an economy. We apply our measure to the US data and document several findings of interest.

First, our recommended measure of debt burden (DaaF-to-GDP ratio) correlates well with the more conventional debt-to-GDP ratio as indicated by a correlation of 0.96 between 1997 and 2013. However, the overall correlation masks significant changes in the relationship between the two measures following the 2008 financial crisis. For instance, using rolling correlations we find that the correlation between the two fell to approximately zero over the two-year period between 10/2010 and 10/2012 before climbing back to 0.83 over the last two years of the sample. Such a break in the relationship can be a result of unorthodox policy reactions to the crisis that affected duration of the debt during this period. Unlike the debt-to-GDP ratio, the DaaF-to-GDP ratio is sensitive to changes in both maturity and interest rates and hence can move independently.

Second, we show that our recommended measure of the debt burden, the DaaF-to-GDP ratio, paints a very different picture for the US economy than the conventional debt-to-GDP ratio. For instance, the debt-to-GDP ratio, fell from around 40% in April 1997 to 32% by September 2008. In contrast, the DaaF-to-GDP ratio fell from approximately 13% in mid-1997 to 10% in September 2008. In September 2008 when the financial crisis began in earnest, the total marketable US debt first surpassed $5 trillion, and debt began growing at a faster rate than GDP. Following the financial crisis, the debt-to-GDP ratio more than doubled by the end of 2013 to nearly 70%. Many pundits and economists openly express fears that the rising debt-to-GDP ratio paints a dire picture of an unsustainable debt burden that may lead to a potential future default by the US. However, during the same time period, the DaaF-to-GDP ratio rose along with the total amount of outstanding debt to just under 17% at the end of 2013. Although the DaaF-to-GDP ratio does increase from the start of the sample, the difference is much smaller in magnitude than the increase in debt-to-GDP. Hence, once we account for the Federal Reserve's ability to suppress long-term interest rates and the Treasury's ability to extend the maturity of the debt, the standard rhetoric of unsustainable debt burden deduced primarily from the debt-to-GDP ratio seems misplaced.

Third, using the projected levels of maturity and debt from the Treasury Department we document the anticipated evolution of the DaaF-to-GDP ratio in the coming years. We find that depending on future interest rates and the mix of debt issuance, the DaaF-to-GDP ratio should be declining or stabilizing over the next decade. In fact, there is a scenario with a roughly stable mix of debt issuance and coupon rates over the next 10 years, where we

could expect the US debt burden as measured by the DaaF-to-GDP ratio to return to levels seen in the late 1990s.

Our results have significant implications for the discourse on debt burden in general and the economic analysis of the rising debt in particular. Although the debt-to-GDP ratio is a quick way of measuring a country's debt burden it misses the key aspects played by long-term interest rates and maturity which complement it as a comparative tool. By using debt-as-a-flow measures, researchers would be better equipped to compare situations of debt burden across countries and determine if certain changes in maturity or interest rates might hinder growth or other macroeconomic factors.

The remainder of the paper is organized as follows. Section 2 provides a brief review of the related literature. Section 3 presents our conceptual framework. Section 4 describes the data, Section 5 compares our measure of debt burden with the debt-to-GDP ratio, and Section 6 concludes.

2. Related Literature

In the literature on debt burden and its impact on economic growth, the debt-to-GDP ratio is used to quantify a nation's debt woes. The alternative we propose in this paper is the DaaF-to-GDP ratio which, in our view, is a more comprehensive and accurate measure of debt burden. In this section we seek to establish the pervasive use of the conventional debt-to-GDP ratio to measure debt burden and hence highlight the significance of the contribution we hope to make to the existing literature. We provide a review of the literature on three pertinent issues. First, what is the effect of rising debt on economic performance? Second,

what are the theoretical channels that permit a government to respond to rising debt levels by changing the maturity of the debt? Lastly, what is the empirical evidence on the nature of the relationship between debt burden and debt maturity?

Cecchetti et al. (2012) used a sample of 18 OECD countries and estimated a dynamic growth model over the period of 1980-2006 using overlapping growth episodes of a 5-year duration. They found that a 10 percentage point increase in debt-to-GDP ratio is associated with an 18 basis point decline in subsequent GDP growth. Kumar and Woo (2010) controlled for possible endogeneity in this relationship and report similar magnitudes for a sample of 30 countries. While Cecchetti et al. (2012) and Kumar and Woo (2010) documented a slight negative relationship between the debt-to-GDP ratio and long-run economic growth, research by Herndon et al. (2013) displayed the negative impacts of growth might be heavily influenced by outlying very-highly indebted countries, with little impact before debt-to-GDP ratios near 120 percent. This evidence points toward non-linearities in the relationship between debt and economic growth, but the threshhold for impact is unclear. For an excellent survey of theoretical and empirical considerations in the growth-debt nexus see Panizza and Presbitero (2013).

This paper is related to the literature on sovereign debt management. Theoretically the link between the size of the sovereign debt and the maturity can be positive or negative. For instance Alesina et al. (1990) and Giavazzi and Pagano (1990) provide a framework where high-debt countries can potentially reduce the probability of a confidence crisis in their debt by actively lengthening the maturity of their debt. The key idea here is that the identity of

the debtor is more important driver of confidence in the market than the nature of the debt instrument itself (Alesina et al., 1990). In such a case the correlation between debt-to-GDP ratio and maturity should be positive. Greenwood et al. (2012) propose a framework where the government optimally chooses the maturity structure of its debt by accounting for the tradeoff between monetary services provided by shorter maturity debt and the possibility of refinancing this debt at higher interest rates. Their model predicts that government debt maturity will be positively correlated with the debt-to-GDP ratio. Missale and Blanchard (1994) focus on the idea that a government with high level of nominal debt has strong incentives to inflate its debt away, which is known to the investors. In such a setting the government can improve the credibility of its anti-inflation stance by decreasing the maturity as debt increases. In this case we should expect a negative relationship between the level of the debt and maturity.

The empirical evidence on the correlation between debt-to-GDP ratio and debt maturity is mixed. For instance, Missale and Blanchard (1994) document a strong negative correlation between these two variables for Belgium, Italy, and Ireland. De Haan et al. (1995) used data on eight OECD countries and found that this correlation is negative for all except the US and Canada. Greenwood et al. (2012) document a strong positive correlation between debt-to-GDP ratio and debt maturity for the US between 1952-2009. One way to rationalize the observed positive correlation for the US is that the signaling motive outlined by Missale and Blanchard (1994) based on inflation or default risk is not a serious concern for US Treasury debt (Greenwood et al., 2012).

3. Debt as a Flow

In this section we present our measure of debt burden based on debt as a flow instead of the conventionally used stock of debt. For this purpose, we begin by highlighting the need to distinguish between maturity and duration of a debt instrument. We use a measure of duration that captures the average time to maturity of payments on coupon-paying bonds. Using the duration, we then define our recommended debt burden measure by converting the nominal debt at any point in time into a flow measure and expressing it as a percentage of nominal GDP.

It is important to distinguish between the maturity of a bond and its duration. The maturity of a bond represents the time until the bond expires. Average maturity can be estimated by weighting each bond in a portfolio by the dollar value of the outstanding debt. Alternatively, the duration of a bond accounts for the coupon payments as well as the variation of interest rates during the lifetime of a bond. For a zero-coupon bond the two concepts are identical. However, for bonds that pay periodic coupons, duration is shorter than maturity. Following Macaulay (1938), for a bond issued at time period t with a face value of $\$F$, and an annual coupon payment of $c = r_j F$ where r_j represents the coupon rate paid at dates $n_1, n_2, ...n_J$ into the future, we define the duration as follows:

$$d_t = \frac{1}{p_t} \sum_{i=j}^{J} [exp(-n_j r_t^{n_j}) n_j CF_j] \tag{1}$$

$$where\ CF_j\ = c\ \forall j \neq J\ and\ CF_J\ =\ c\ +\ F$$

where p_t represents the price of the bond and r_t^n is the interest rate from a zero-coupon yield

curve.

Using the above measure of duration we compute DaaF as follows:

$$DaaF_t = \frac{X_t}{d_t} \tag{2}$$

where X_t is the total outstanding debt at time t. The $DaaF_t$ can be interpreted as the amount of debt owed in each year and hence is a flow measure. Note that one can obtain a flow measure by simply dividing the outstanding debt with the available maturity measures instead of computing the duration. As we show later, such a definition ignores the important role played by interest rates which are often expected to rise when debt burden increases. Hence, we recommend the use of duration for computing a measure of debt as a flow.

Once the DaaF measure is estimated, it is divided by an annualized GDP measure to yield a unit-less ratio which represents the percentage of GDP that would be used towards debt repayment at a given point of time. For instance, a value of 0.1 for this ratio implies that 10 percent of GDP must either be refinanced, repaid, or issued. We call this the "DaaF-to-GDP" ratio and propose that it is a more accurate measure of a nation's debt burden than the conventional debt-to-GDP ratio. We substantiate our claim with the help of an illustrative example. Consider a country with an annual GDP of \$1 trillion, a debt of \$0.5 trillion, and an average debt duration of five years. In this case, the DaaF-to-GDP ratio is 0.1 implying a debt burden of 10 percent of GDP for each of the five years of the duration. Suppose this country experiences a recession which leads to a rising debt through any combination of reduced revenues or increased spending by the government. For simplicity, suppose that an increase in debt to \$0.8 trillion coincides with the pre-recession GDP level of \$1 trillion. One

possible scenario is that the authorities responsible for financing the debt are able to extend the duration to say, eight years. As a result, the post-recession DaaF-to-GDP ratio remains at 0.1, and the annual debt burden remains at the pre-recession level. In a different scenario, the country's authorities might choose or be forced into reducing the average maturity and duration of their debt if bond markets signal their skepticism about repayment, and long-term interest rates move much higher. If duration declined from say, five to two years when GDP finally recovers, the DaaF-to-GDP ratio would rise to 0.4 implying a higher post-recession debt burden of 40% of annual income. In contrast, regardless of the change in the duration caused by debt management policy followed by the authorities, the debt-to-GDP ratio would have shown an increase from pre-recession value of 0.5 to the post-recession value of 0.8. However, the ability to service the debt in our example is more severely hampered in the latter scenario of shortening duration than the former scenario of lengthening duration—a fact that cannot be captured by an analysis of debt burden focused on the debt-to-GDP ratio. This example illustrates our main objection to using the debt-to-GDP ratio as a measure of debt burden. It can be reasonably argued that the policymakers may actively engage in debt management in response to rising debt levels, primarily through changing the duration of the debt (Alesina et al., 1990; Missale and Blanchard, 1994; Giavazzi and Pagano, 1990). Against the backdrop of rising debt levels, the incidence of debt burden is smaller (bigger) for a country with the possibility to extend (shorten) its debt maturity. Such an insight is captured in our recommended measure of DaaF-to-GDP ratio but is beyond the conventional debt-to-GDP ratio. Further research using DaaF-to-GDP ratios may help

measure a country's ability to withstand crises which impact interest rates or the ability for a country to issue debt.

As discussed earlier in Section 2, many studies have found that there is a positive historical correlation between the debt burden and the debt maturity for the US. Since the 2008 recession, the US has experienced a sharp increase in the level of outstanding debt that has attracted sharp scrutiny of the US debt policy and its growth consequences, based primarily on the conventional "debt-to-GDP" ratio. This gives rise to an important and pertinent question. How would the US debt burden appear currently and how would it evolve into the near future if one accounts for the observed increase in debt duration? We seek to answer this question in the next section.

4. Data and Main Results

4.1. Data

There are three primary data sources used for creation of the monthly DaaF-to-GDP measures. The US Treasury has made electronic versions of the Monthly Statement of the Public Debt available for all marketable debt between April 1997 through the end of the sample in December 2013. Annualized nominal GDP is available on a monthly frequency from Macroeconomic Advisers.[4] In order to estimate duration, the zero coupon 30-year yield curve is obtained from Gurkaynak et al. (2006) who estimate the yield curve for the entire maturity range of the US Treasury securities at daily frequency since 1961. These data are regularly updated and includes high frequency data zero-coupon yields, par yields, and forward rates.[5]

[4] http://www.macroadvisers.com/monthly-gdp/.

[5] http://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html

Each monthly statement is compiled to find a monthly aggregate marketable debt and an overall duration measure. These measures are then used to calculate duration-based DaaF and DaaF-to-GDP ratios.

4.2. Maturity vs. Duration

Figure 1 documents the evolution of the marketable US Treasury debt by the type of issue. We observe that the mix of marketable debt issued by the US Treasury has evolved over time, with a rapid increase in the amount of money-market instruments in late 2008, followed by a rapid increase in note and bond issuance to replace some of the shorter term issues. At the end of the sample period, approximately 2/3rd of marketable debt was in the form of medium-term notes. An increase in the share of short-term debt should reduce average maturity and duration whereas a greater proportion for the medium to long-term debt should increase both, a fact borne out in our next exhibit.

[[[Figure 1 about here]]]

Both maturity and duration have evolved in a similar fashion during the sample period, with a noticeable decline in both towards the end of 2008 (Figure 2). The sudden decline in maturity and duration is most likely due to the large increase in money-market issuance in late 2008. The stability of maturity and duration in longer-term debt when compared to the rapid change in the same portfolio when including short-term debt displays how government demands for liquidity can affect overall duration variables.

[[[Figure 2 about here]]]

An important note about Figure 2 that may not be readily apparent is the declining spread between maturity and duration over the sample period. In Figure 3 we plot the log difference between duration and maturity, along with the ten-year Treasury rate. The average log difference between duration and maturity-based DaaF is 0.42 for our sample period. Furthermore, there is a clear downward trend in the log difference between the two. Given our objective of providing a more accurate picture of the debt burden, this is a primary reason for our use of duration rather than the more readily available maturity data when estimating debt as a flow. Using maturity notably understates the debt burden by ignoring the cost of refinancing or repaying coupon payments which are necessary where bonds pay periodic interest. In December 2013, DaaF using maturity was approximately $740 billion per year lower than the $2.87 trillion DaaF estimated using duration.[6] Figure 3 also displays the close correlation between the ten-year Treasury rate and the difference between maturity and duration. Later, we use this relationship to project the maturity to duration ratio into the future (see Section 5.2).

[[[Figure 3 about here]]]

[6] We also carried out the analysis presented in the next section (Section 5) using maturity to compute the DaaF. The results of this exercise are not reported here for brevity and are available upon request.

5. Measuring debt burden: DaaF-to-GDP vs Debt-to-GDP

In this section we contrast the secular behavior of our recommended measure of the debt burden with the conventional debt-to-GDP ratio. We first present the historical comparison of the two ratios which is followed by a discussion on the projected differences between the two over the next decade.

5.1. An in-sample comparison

As previously mentioned, the DaaF-to-GDP and debt-to-GDP ratios appear to be closely related with a correlation of 0.96 over the entire sample.[7] However, the overall correlation masks the breakdown in this relationship following the rather unorthodox fiscal and monetary policy reactions to the 2008 crisis which impacted the duration of the debt. The DaaF-to-GDP ratio that accounts for duration is able to incorporate these changes, whereas the conventional debt-to-GDP ratio is insensitive to them. This partly explains the inconsistent correlation between the two series after 2008. In Figure 4 we plot the DaaF-to-GDP ratio alongside the debt-to-GDP ratio. We observe that although both ratios witnessed an increase post 2008, the rise in debt-to-GDP ratio was much faster—an image that casts a far more frightening picture of the debt burden for the US economy. For instance, the DaaF-to-GDP ratio jumped from 0.10 in August 2008 to 0.15 in January 2009, and then further increased to 0.17 at the end of 2013. Hence, the DaaF-to-GDP increased by a factor of 1.67 during this period. On the other hand, the debt-to-GDP ratio also increased by a factor of 2.12

[7]Note that all measures of DaaF, marketable debt, and GDP are not adjusted for inflation.

which more than doubled the ratio. The difference between these factors of growth from the moment the crisis began might seem minor at first. However, a look at how the two ratios at the end of 2013 compare with their respective values at the beginning of the sample paints a different picture. Over the entire sample, the growth rates for the DaaF-to-GDP and debt-to-GDP ratios are 22 and 71 percent, respectively. Hence, although both measures exhibit significant increases in debt burden over the sample period, any analysis based on the debt-to-GDP ratio is prone to vastly understate the ability of the US to service their debt.

While these comparisons are important to understand, the two series are not fundamentally comparable based on their difference in units. As discussed in Section 2, much has been made of behavioral thresholds in the debt-to-GDP ratio that approach or exceed 100%. Debt-to-GDP ratios near one year of output may have negative growth implications (Cecchetti et al., 2012). However, this threshold of one or two years of output does not necessarily signal an impending default. It may be that debt-to-GDP is a weak signal about the state of the economy, markets, or impending sovereign default. Drehmann and Juselius (2012) examine the debt service ratio ("DSR") of the household sector versus an aggregate credit-to-GDP ratio. The DSR and credit-to-GDP variables are household sector variants of the DaaF-to-GDP and debt-to-GDP values studied here. Drehmann and Juselius (2012) find that the DSR and credit-to-GDP ratio are complementary indicators, with the DSR providing a reliable short-term signal of future recessions and crises versus the credit-to-GDP ratio which appears more useful over longer horizons.

[[[Figure 4 about here]]]

5.2. Projections

Finally, we present the projected trajectory for the two measures of the debt burden. The projections for debt-to-GDP ratio are provided by the Congressional Budget Office (CBO). The estimated debt-to-GDP ratio in the US is projected to remain stable over the coming 10-year budget window, first rising slightly from 72.1% in 2013 before falling to 69.0% in 2023.[8] In order to project the DaaF-to-GDP ratio we use official projections for nominal GDP, outstanding marketable debt, maturity, and 10-year Treasury rates. Economic assumptions about nominal GDP and interest rates are obtained from Table S-12 of Congressional Budget Office (2014) and projected debt is taken from slide 23 of Office of Debt Management, U.S. Department of Treasury (2014). In order to predict future values of duration we use the information on projected maturity of the marketable debt from the Treasury department.[9] The duration of debt relative to the projected maturities is estimated under two alternative scenarios. First, we consider the case where the log difference between maturity and duration (LMLD, henceforth) stays at its December 2013 value of 0.3 for the next 10 years. Second, we estimate the historical relationship between the LMLD and the ten-year Treasury yield using a linear regression. The predicted LMLD from this regression using the expected ten

[8]Table S-13 in Congressional Budget Office (2014).

[9]Office of Debt Management, U.S. Department of Treasury (2014) provides full detail on slide 23 of how the Treasury Department projections for future maturities are made. While detailed projections were not available for our analysis, projected fiscal year-end values were estimated using the "Recent and Projected Maturity Profile" as provided in slide 23 of Office of Debt Management, U.S. Department of Treasury (2014). The April 2014 Monthly Statement of the Public Debt provides a quick way of estimating the average maturity for debts expiring in < 1 year, $[1, 2)$ years, and so forth (`http://www.treasurydirect.gov/govt/reports/pd/mspd/mspd.htm`). These estimated maturities aim to match the present portfolio in an information neutral way by not assuming any changes to mix of securities issued by the Treasury, and yet achieve the level of debt projected by Office of Management and Budget (2013).

year-yield gives us the projected LMLD between 2013-2023. Figure 5 displays the projected DaaF-to-GDP ratio under the two assumptions described above. We also plot the CBO projections for the debt-to-GDP ratio for comparison. First, any change in projected maturity as emphasized by the Treasury department will have no effect on the debt-to-GDP ratio and hence it is expected to remain rather stable around 0.7 between 2013 and 2023. On the other hand, the projected behavior of the DaaF-to-GDP ratio depends on what happens to projected maturity and interest rates over the next ten years. If coupon rates and the mix of debt issuance remains relatively stable over the next decade we can expect the relationship between maturity and duration to be roughly the same as toward the end of 2013. In this case, we could expect our debt burden as measured by the DaaF-to-GDP ratio to return to levels seen in the late 1990s, with the DaaF-to-GDP ratio to falling from 0.168 in December 2013 to about 0.136 at the end of fiscal year 2023 (Figure 5: Current). However, if the average maturity of debt rises faster than the duration and the difference is in line with the projected values from higher long-term interest rates, then the DaaF-to-GDP ratio would fall only slightly to 0.163 at the end of 2013 and will be approximately in line with the debt burden as measured at the end of 2013.

[[[Figure 5 about here]]]

6. Conclusion

In this paper we emphasize the importance of measuring debt burden using a flow measure of the debt we call "DaaF." Using historical data from the Treasury department we document

that the conventional debt-to-GDP ratio tends to overstate the incidence of debt burden and also fails to accommodate any debt management practices by the Treasury that may affect the duration of the debt. We find that using our recommended DaaF-to-GDP ratio as a measure of debt burden paints a more reasonable and accurate picture of the US debt repayment capacity. Although the rapid increase in debt levels brought on by the financial crisis did lead to a coincident rise in both the debt-to-GDP ratio and the DaaF-to-GDP ratio, the indicator presented here remains in line with historic values and is projected to stabilize in the next ten years. While the evidence presented here does not claim that the debt-to-GDP ratio should be wholly replaced in the studies of debt analysis, economists should consider not only the level of debt, but also account for the Treasury's ability to extend duration of the debt and the central bank's ability to manage long-term interest rates.

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Figure 1: Marketable Debt by Type of Issue

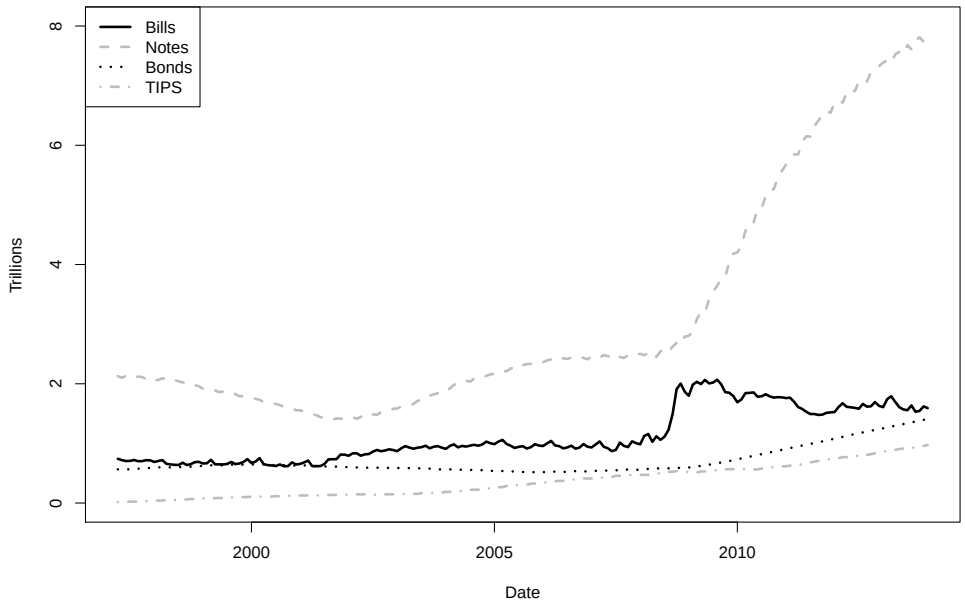

Figure 2: Maturity and Duration Including and Excluding Bills

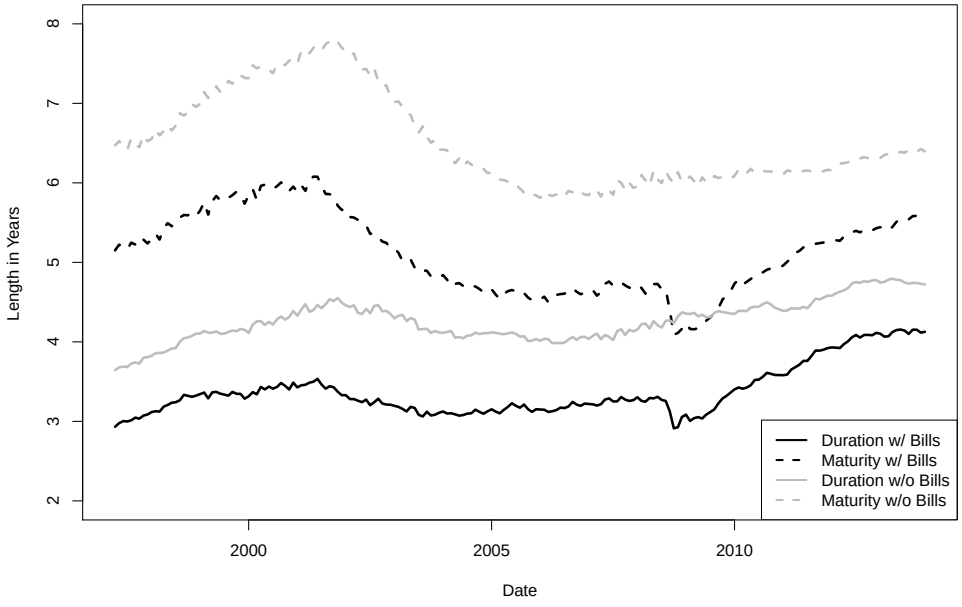

Figure 3: 10-Year Interest Rates and Difference Between Maturity and Duration

Figure 4: Debt to GDP Ratio and DaaF to GDP Ratio

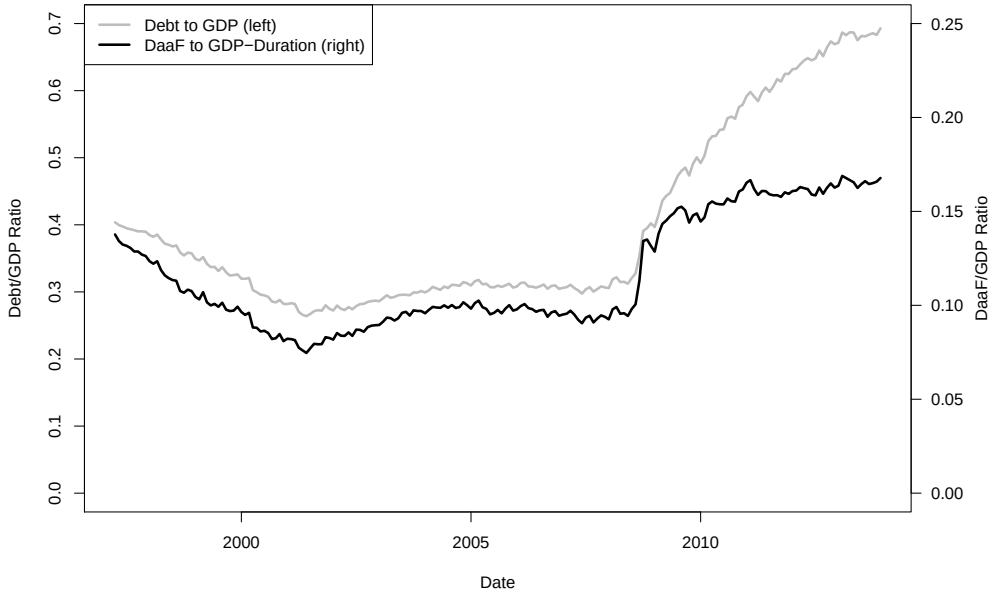

Figure 5: Projections of Debt to GDP Ratio and DaaF to GDP Ratio