TBAC Charge – Update of Model Results for Optimal Treasury Debt Structure

- *Since the start of the pandemic, there have been substantial changes to macroeconomic conditions, fiscal and monetary policy, and Treasury issuance. Given these changes, pursuant to the extensive TBAC work over the last several years on an optimal debt model, please provide an update on the output of the model. How have the model's results changed and what have been the main drivers of those changes? What insights can the model offer about the current stock of debt and upcoming issuance decisions?*

Executive Summary

- This presentation provides an update on the output of the optimal debt issuance model that has been used previously by TBAC.[1] The update shows the model results as of the end of the first quarter of 2022 and compares them to the results from the last quarter of 2019, just before the onset of the COVID-19 pandemic.
- While model outputs should not be (and are not being) used prescriptively, they do provide a number of insights on how the shift in the macroeconomic and fiscal environments, along with the debt issuance decisions made over this period, have affected the expected cost of U.S. debt and the risks surrounding these costs.
- The model results show that the Treasury faces a less favorable frontier for the expected cost of its debt at given levels of risk relative to the situation in 2019Q4. This outward shift in the frontier mainly reflects the increased size of the outstanding debt stock, with only a small portion explained by the change in the macroeconomic environment.
  - The shift in the macroeconomic environment is seen as less important in the model in part because of the substantial mean-reverting properties of the model
  - Alternative model structures that do not assume the same degree of mean reversion could produce different conclusions
  - In addition, this version of the model includes the full stock of outstanding debt, without taking into consideration the effects of the SOMA portfolio
- Similar to previous results, the model continues to see increased issuance of Bills, short- and intermediate-maturity Notes, TIPS, and FRNs as most favorable. According to the results, the expected cost of Treasury debt could be lowered by several tenths of a percent of GDP, with only limited incremental risk to the overall fiscal deficit, by shifting issuance in those directions.

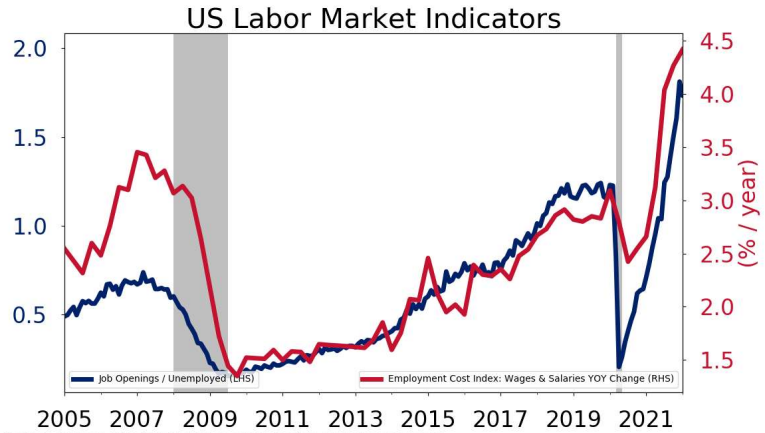
[1]Belton, Dawsey, Greenlaw, Li, Ramaswamy, and Sack, "Optimizing the maturity structure of U.S. Treasury debt: A model-based framework", The Hutchins Center on Fiscal and Monetary Policy, Brookings Institution (October 10, 2018). https://www.brookings.edu/research/optimizing-the-maturity-structure-of-u-s-treasury-debt/

Macroeconomic, Fiscal, and Market Context

Change in Macroeconomic Environment

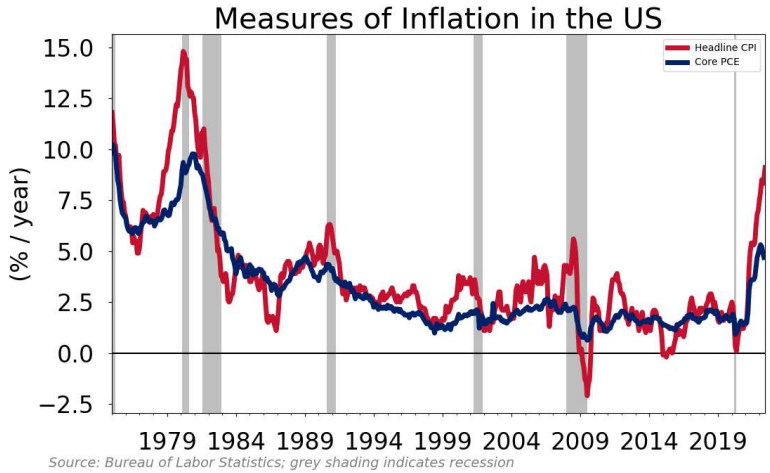
As the US emerges from the COVID-19 pandemic, supply / demand imbalances have driven the economy into a period of elevated inflation.

After experiencing significant job losses during 2020, the labor market is now extremely tight



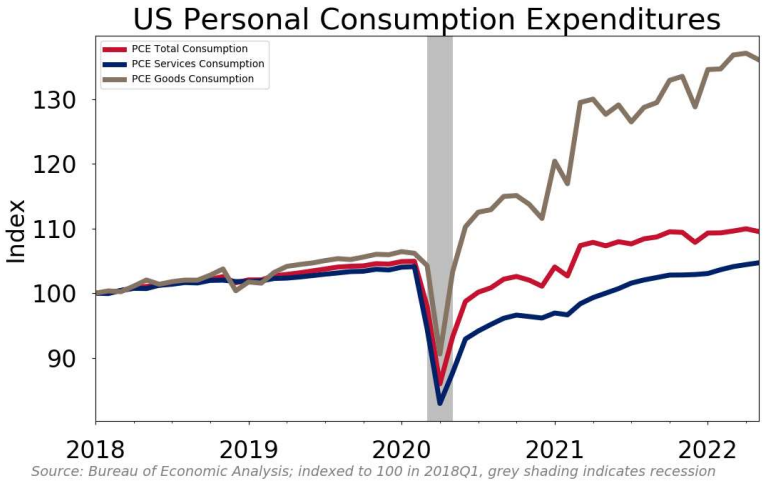
Source: Bureau of Labor Statistics; grey shading indicates recession

The demand for labor, significant changes in consumption behavior, supply chain disruptions, and global events have resulted in inflation reaching multi-decade highs



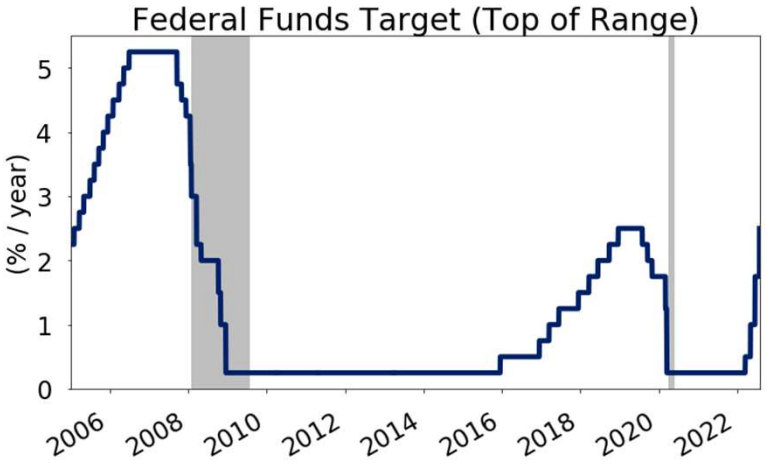
Source: Bureau of Labor Statistics; grey shading indicates recession

Overall consumption has returned to trend, but goods consumption is extremely elevated relative to pre-pandemic levels, while services consumption is lagging



Source: Bureau of Economic Analysis; indexed to 100 in 2018Q1, grey shading indicates recession

In response, the Federal Reserve has begun to raise the target range for the Federal Funds Rate aggressively

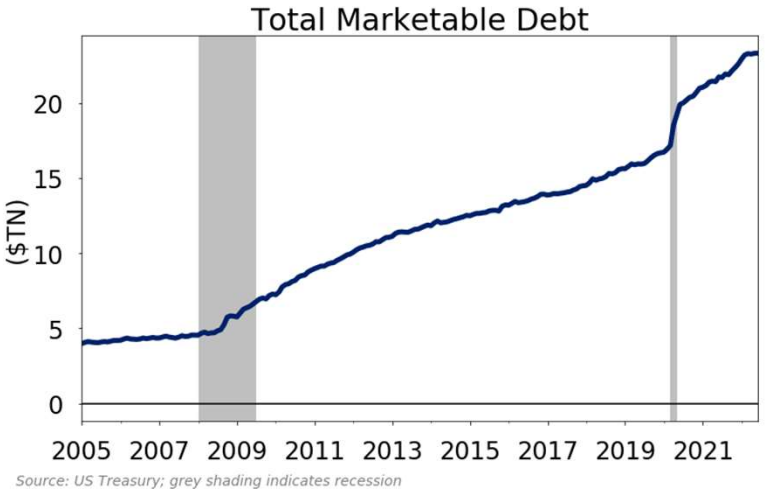


Source: Federal Reserve; grey shading indicates recession

Change in Fiscal and Monetary Environment

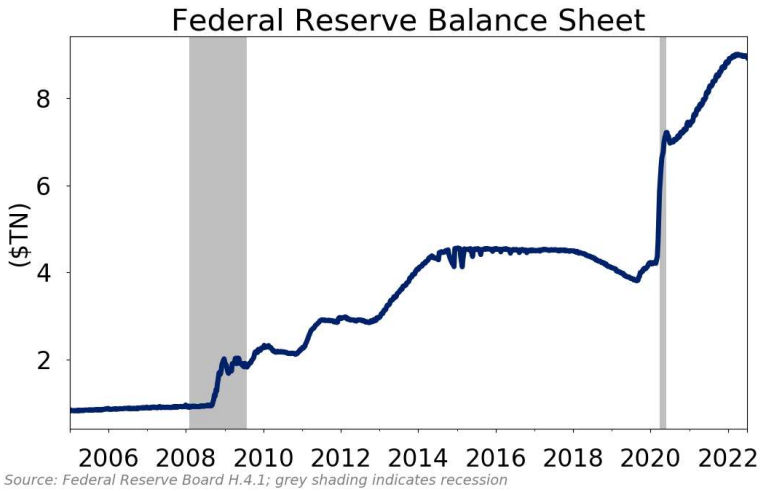
The US government's response to the COVID-19 pandemic included large fiscal outlays and an increase in the public debt. Separately, the Federal Reserve significantly increased its balance sheet.

Treasury total marketable debt has increased $6.6TN since the end of 2019Q4, up about 40%.



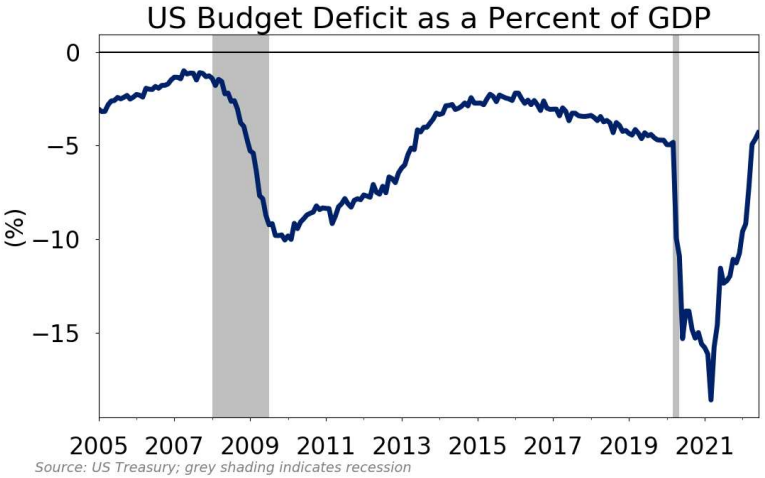
Source: US Treasury; grey shading indicates recession

The balance sheet of the Federal Reserve has increased $4.7TN since the end of 2019Q4, up more than 100%.



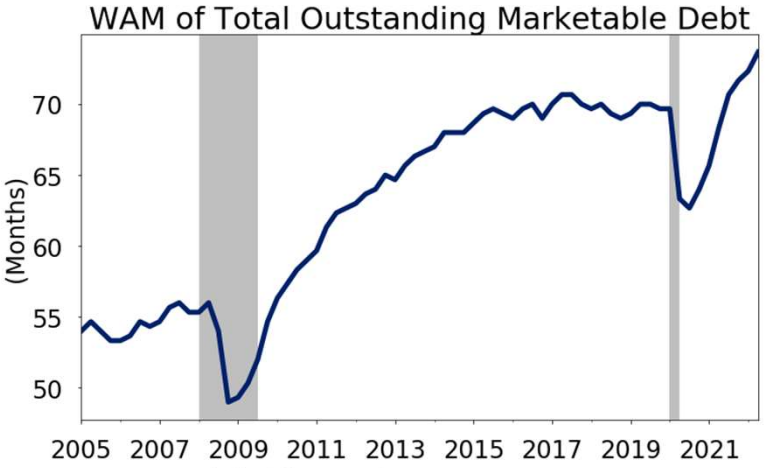
Source: Federal Reserve Board H.4.1; grey shading indicates recession

The Federal budget deficit has averaged -11.4% of GDP since 2019Q4



Source: US Treasury; grey shading indicates recession

The weighted average maturity (WAM) of Treasury marketable debt has increased from 69.7 months pre-pandemic to 74.3 months currently

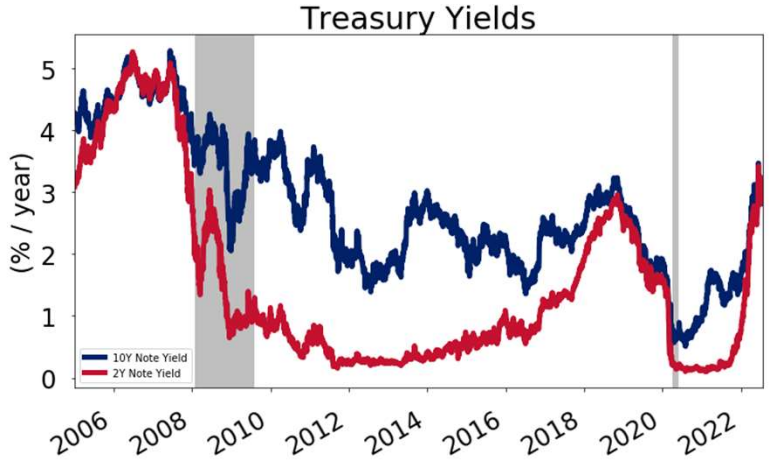


Source: US Treasury; grey shading indicates recession

Change in Financial Market Environment

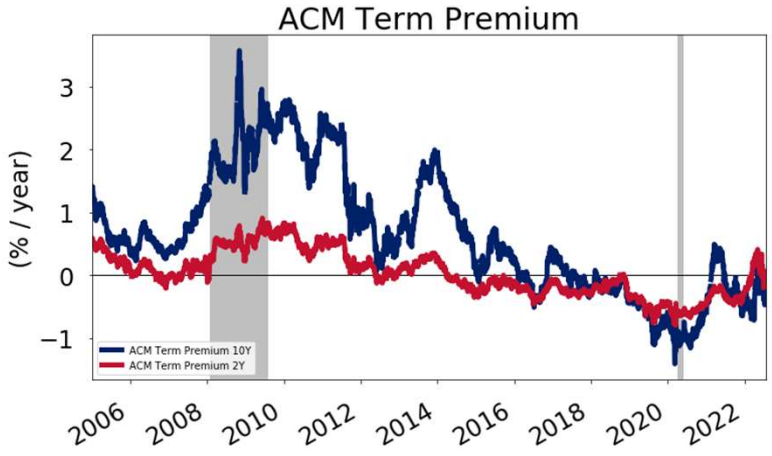
After an initial steep decline at the onset of the pandemic, US bond market yields have responded to the rapid pace of Fed tightening, largely returning to pre-pandemic levels or higher.

Treasury yields, after dropping to historic lows, have now risen and are above pre-pandemic levels



Source: Bloomberg; grey shading indicates recession

Some of the increase in Treasury yields has been due to an increase in term premium

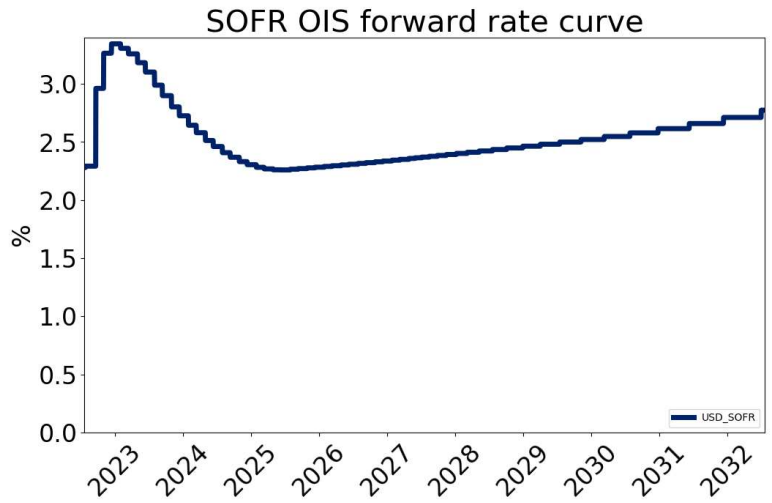


Source: Federal Reserve Bank of New York; grey shading indicates recession

Spot market measures of inflation have increased significantly, but market implied forward inflation expectations remain contained. Real rates have risen significantly.

Source: Bloomberg; grey shading indicates recession

The forward curve implies a continuation of Fed hikes but then a quick reversal, likely due to the risk of the Fed responding to a slowing economy



Model Review and Outputs

Model Description

- The debt optimization model contains:
  - A macroeconomic model for the unemployment gap, core PCE inflation, headline CPI, the Fed Funds target rate, the rate of change of potential real GDP, and the equilibrium real rate of interest
  - A model for the nominal and real Treasury yield curves using expected Fed policy and risk premiums
  - A fiscal equation for the primary budget deficit
  - A debt dynamics module that tracks debt based on current and future issuance of Bills, Notes, Bonds, TIPS, and FRNs

- The model can be used to assess the effects of various hypothetical debt management decisions:
  - It can trace out frontiers reflecting the trade-off between expected debt cost and risk under various issuance strategies
  - It can be used to optimize static issuance strategies (in which issuance fractions are held constant)
  - And it can be used for dynamic optimizations (in which issuance fractions depend on macro variables)

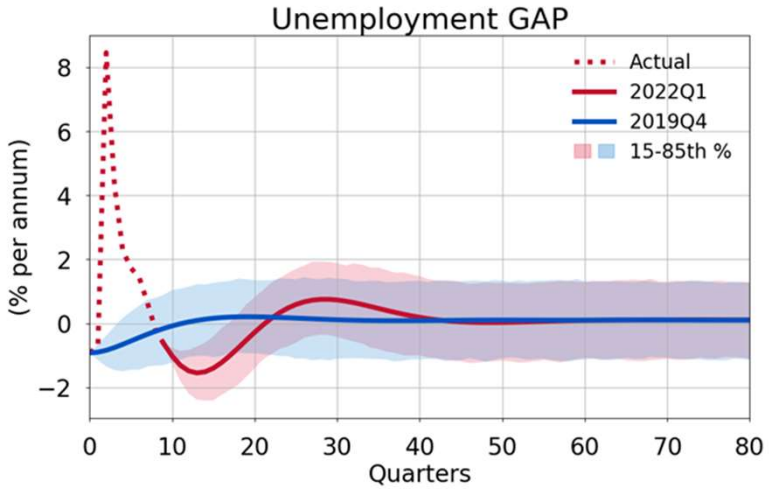
- The results of the model are forward looking
  - These results are affected by the macroeconomic, financial market, and fiscal conditions prevailing at the start of the simulation.
  - Following previous work, we focus on the distribution of debt outcomes at a horizon of 20 years.

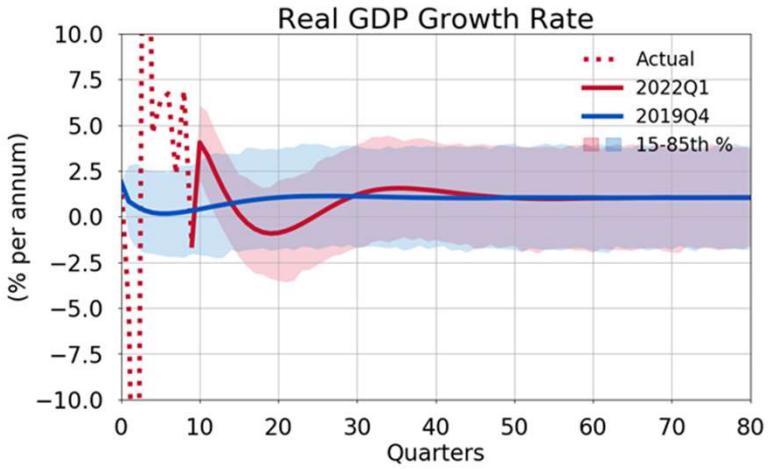
- None of the parameters that determine the forward evolution of model macroeconomic and rates variables have been changed since the last time the model was used. However, we did make a few changes to the model:
  - The Bond kernel has been modified to include the 20Y Bond, with 20Y and 30Y issued at their current ratio.
  - An additional liquidity premium has been introduced for the 20Y Bond. This liquidity premium begins at 15 bp and linearly drops to zero over 5 years.
  - We are using the last published value of Laubach-Williams R-star as the initial value, and imputing long term R-star from the FOMC Summary of Economic Projections.

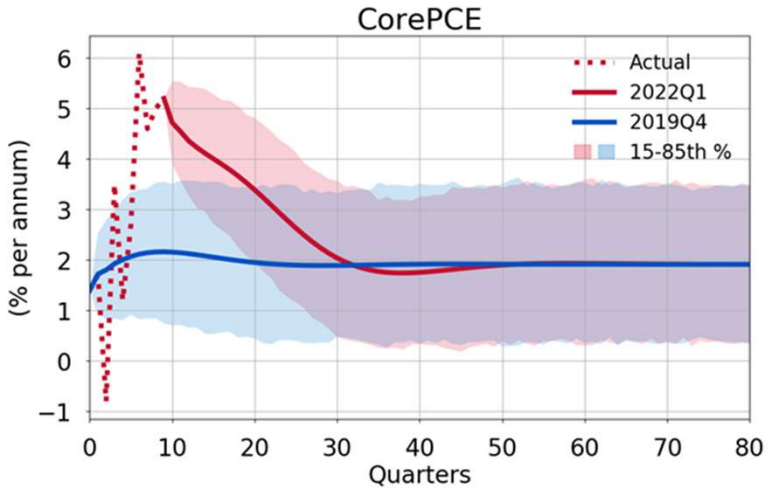
- The model implementation is the author's and is the source for all of the charts displayed in what follows. Another implementation of the model is now publicly available, courtesy of the Hutchins Center at the Brookings Institution, at the Brookings Institution GitHub: https://github.com/BrookingsInstitution/Treasury-Issuance-Model.
  - These results of these two code bases are largely in agreement, although there are some small differences.

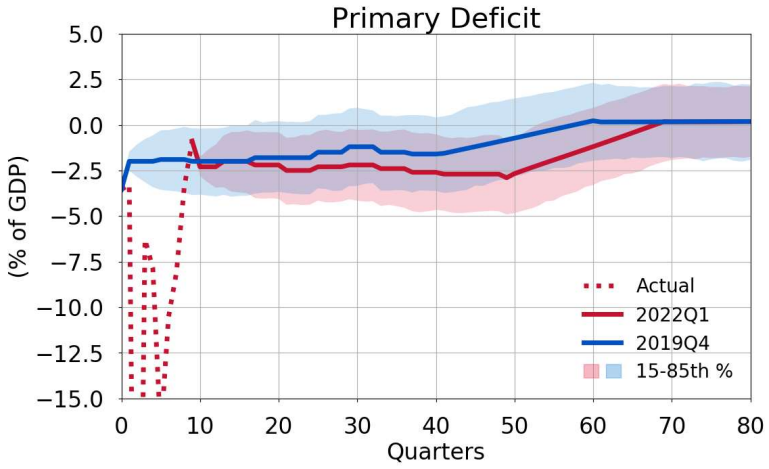
Model Macroeconomic and Fiscal Variable Behavior

We display simulated paths from 2019Q4, and actual paths + simulated paths from 2022Q1. We display the sample mean and 15%/85% percentile bands for a collection of model variables.



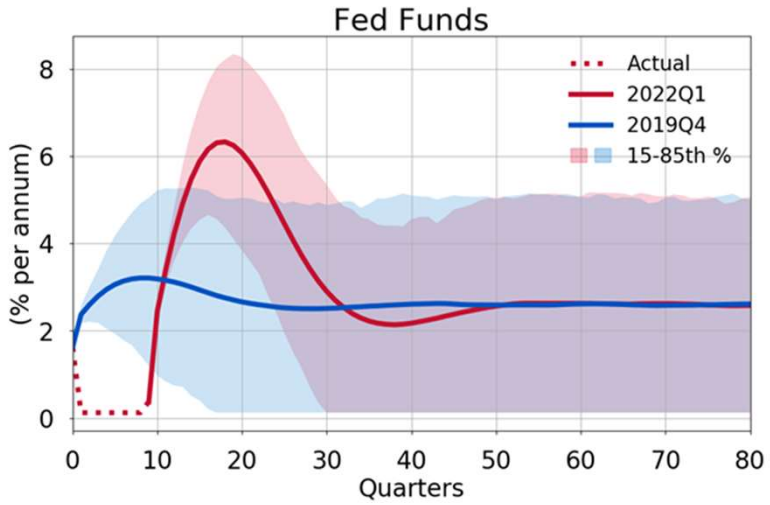


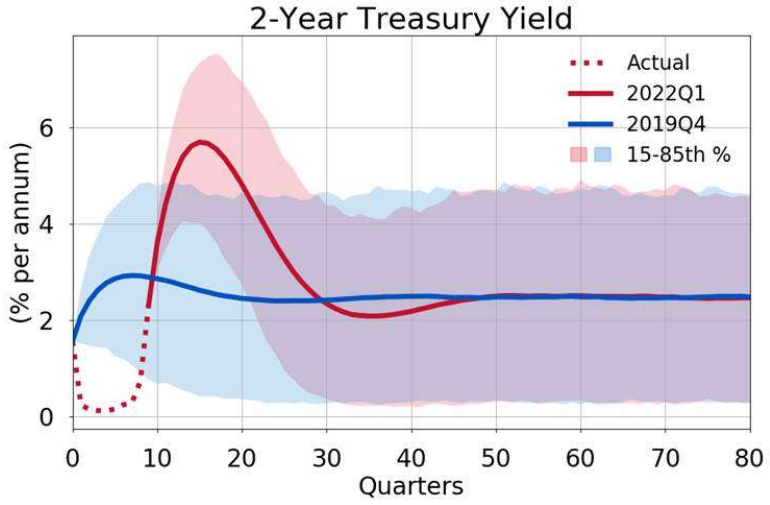


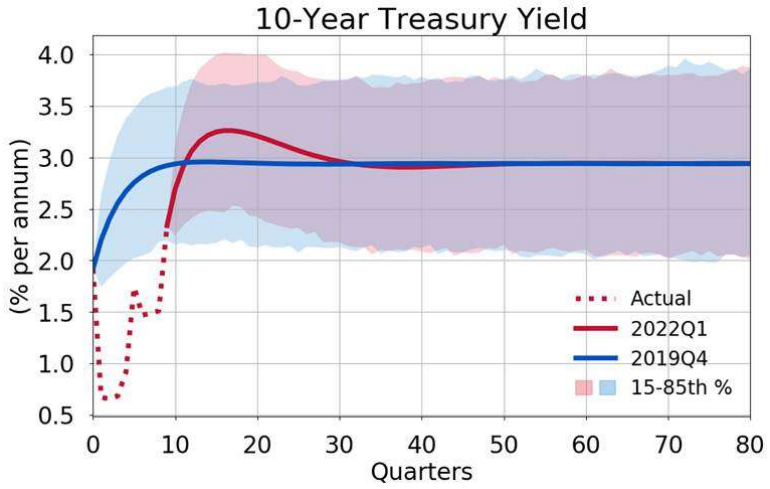


Model Rates Variable Behavior

We display simulated paths from 2019Q4, and actual paths + simulated paths from 2022Q1. We display the sample mean and 15%/85% percentile bands for a collection of model variables.







- The different initial conditions have a strong effect on the path of various variables in the model, but the terminal distributions are not significantly different.
- The cost and variability of an issuance strategy does depend on the entire path, however, so it is important to note the significantly different evolutions implied by the two sets of initial conditions.
- While the macroeconomic and rates models are useful for analyzing long-term effects of debt management decisions, they are not sophisticated forecasting models and these outputs should not be understood as taking a meaningful view on the near-term outlook for rates or the economy

Model Output: Single Security Issuance Strategies

Results show average debt service cost in year 20 versus two different measures of variance across the path population.

- In the model, economic variables (such as inflation, the unemployment gap, etc.), interest rates, and the primary budget deficit are forecasted first along each path in the simulation. These depend only on the initial conditions put into the model, and the model's own internal equations used to generate evolution along the paths; they are independent of the choice of issuance.

- The control variable in the model is the choice of how to issue debt at each time step and on each path of the simulation, and is called the issuance strategy.

- Strategy results are evaluated on the basis of expected future cost (debt service) versus risk (variation of either debt service or deficit).

- While the model has the ability to vary issuance strategies at each time step and along each path in response to the changes of various macroeconomic variables, we do not employ that technology here. Instead, we focus only on static issuance strategies, for which an array of issuance percentages is applied to all the available Bills, Notes, Bonds, TIPS, and FRNs. The results for such a static strategy reflect the outcome should Treasury pick a single strategy and not change it for the next 20 years.

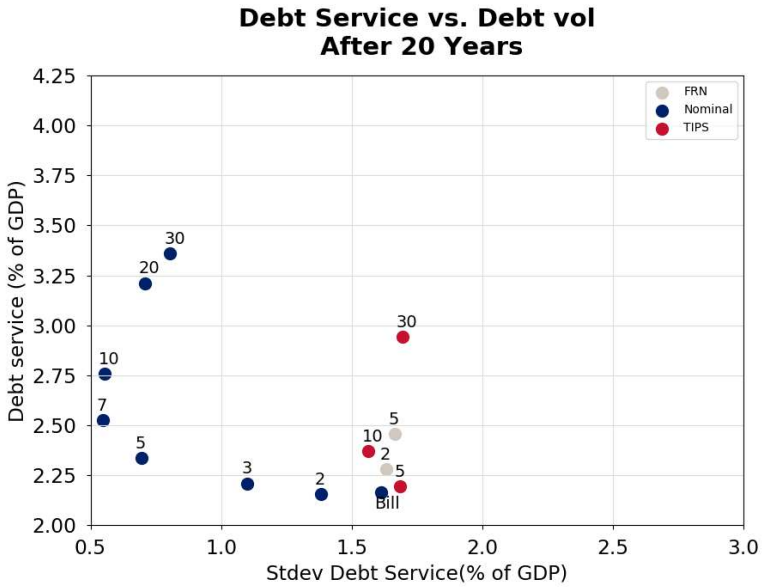
- We begin by considering single security issuance strategies, in which one element of the array is 100%, and the rest are 0%. That is, the Treasury chooses to issue nothing but Bills, or nothing but 2Y Notes, or nothing but long Bonds, for the next 20 years.
  - These strategies are of course unrealistic, but they serve to illustrate the properties of each of the available securities under the assumptions of the model.

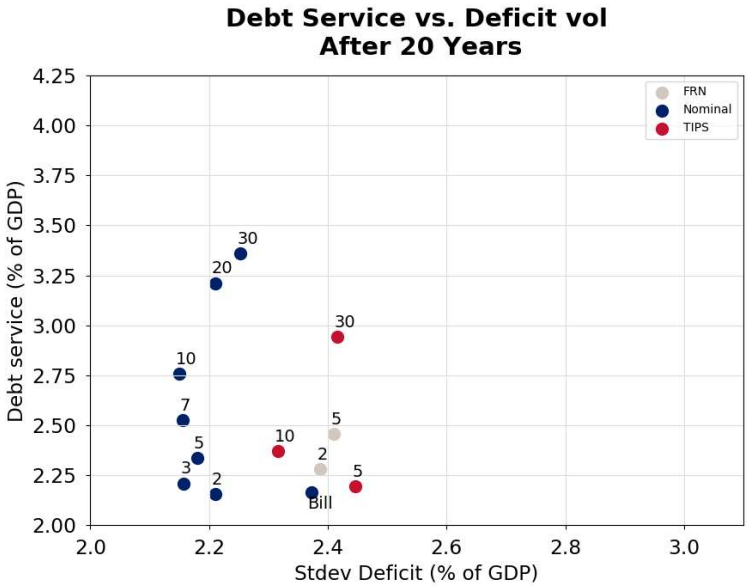
- Single security issuance plots are displayed on the next page. The qualitative behavior of the strategies remains the same from 2019Q4 to 2022Q1, with all strategies shifting up and to the right.

Model Output: Single Security Issuance Plots

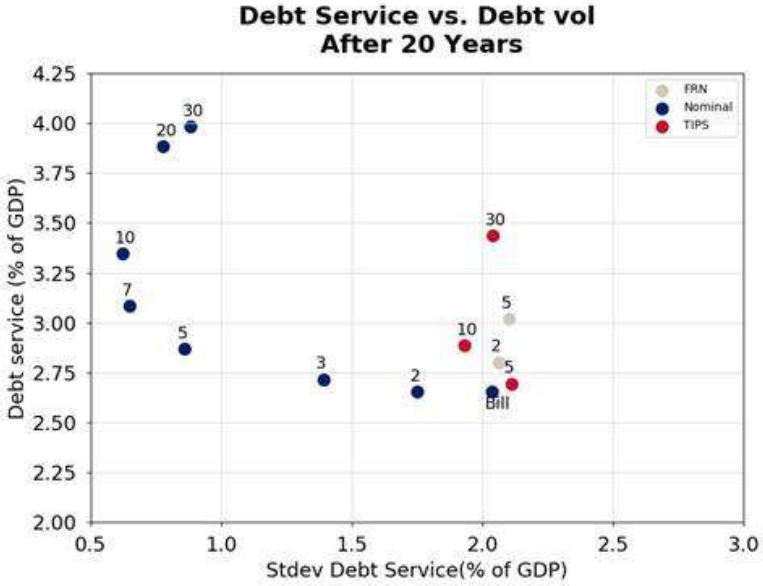
Single security issuance results have shifted up and to the right (more cost and more volatility), primarily due to the increased size of the stock of Treasury debt.

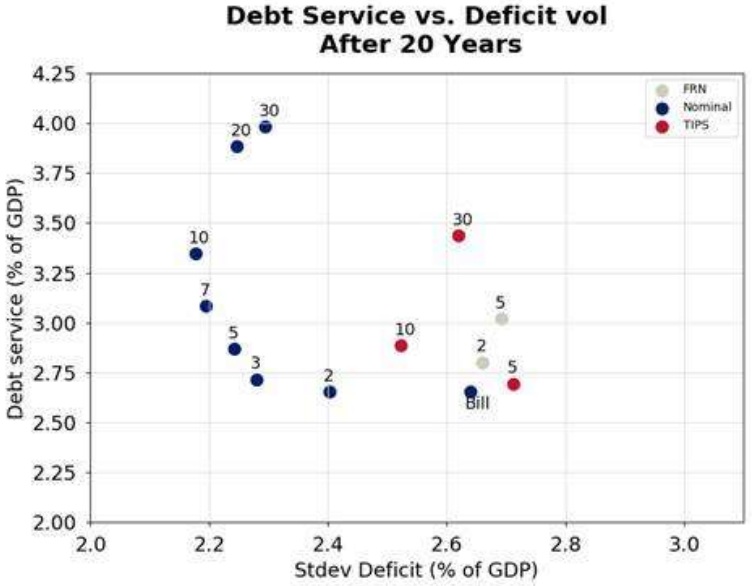
2019Q4





2022Q1



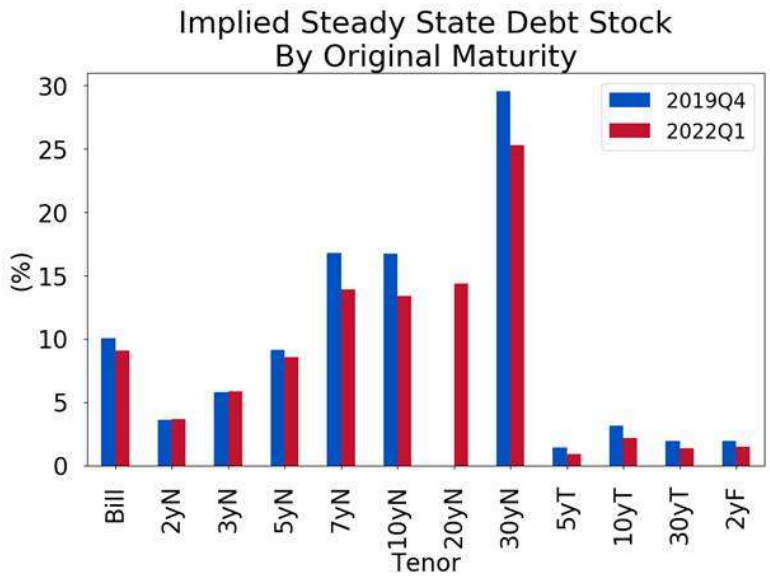


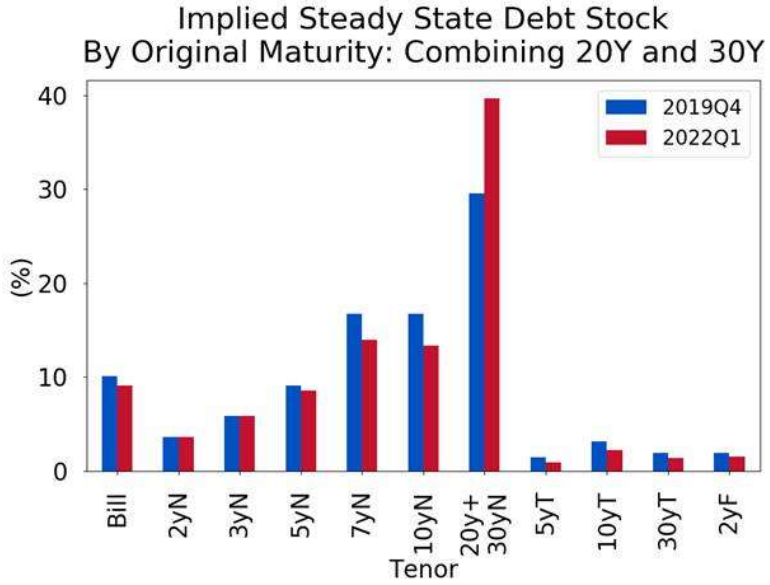
Impact of Current Debt Management Choices

Historical Issuance

Projecting observed Treasury issuance patterns

- We can evaluate the Treasury issuance pattern at a given point in time by assuming it is a static strategy that will be maintained going forward.
- The steady-state debt stocks[1] implied by Treasury's issuance patterns in 2019Q4 and 2022Q1 are displayed to the right. These show the steady-state amount of outstanding debt, grouped by original issue maturity.
- The charts show the effect of changes to the issuance strategy post the onset of the pandemic. The most notable change was the introduction of the 20Y Bond, which involved a relative decrease in issuance of Bills, 5Y – 10Y Notes, 30Y Bonds, TIPS, and FRNs.
- The second chart highlights the significant increase in long-end issuance by combining 20Y and 30Y into a single bucket. This demonstrates how the change in issuance is dominated by the increased supply in the long end.
- We compare these strategies in the different environments in what follows.
- The assumption that Treasury would not modify its issuance pattern over the course of 20 years is not reasonable; nevertheless, these analyses can provide a way to compare issuance choices and suggest changes.



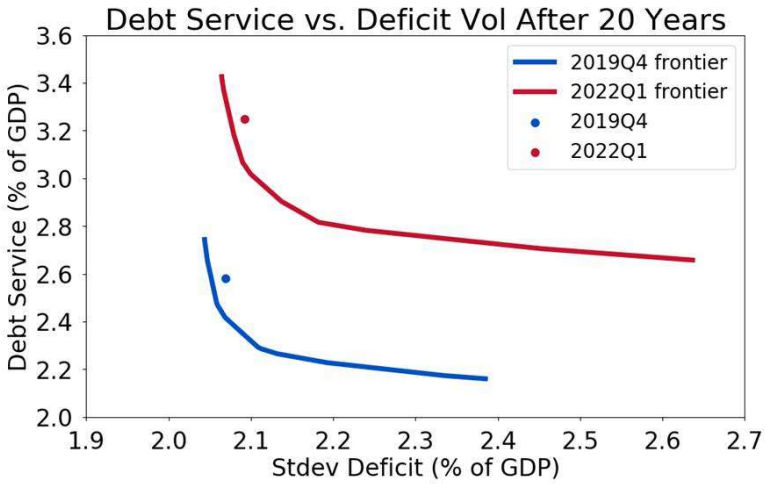


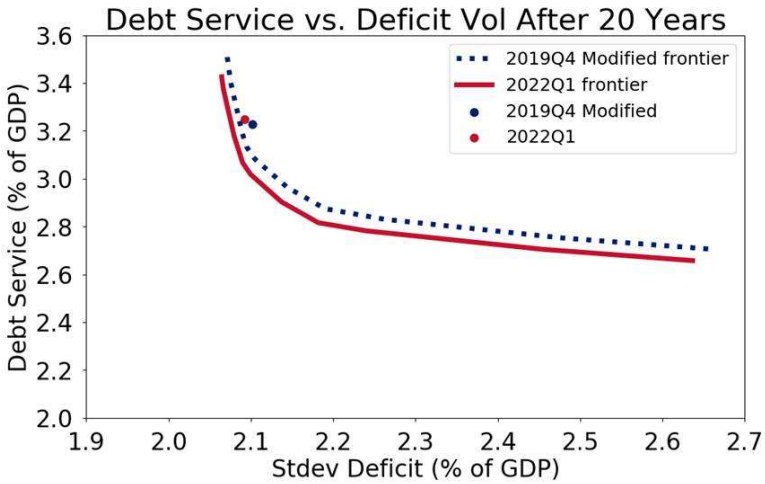
[1]For a review of how to derive the steady-state debt stock from a given quarterly or annual issuance pattern, see the Appendix to the charge "Fixed vs. Floating Rate Treasury Securities", published in the 2019Q2 quarterly refunding documents

Efficient Frontiers and Historical Issuance

Macroeconomic and fiscal environment just before the pandemic compared to recent environment

- Efficient frontiers are obtained by comparing the trade-off between debt service and the standard deviation of the deficit under various static issuance strategies.
- Here we compare the model efficient frontier using macroeconomic and fiscal environments observed at the end of 2019Q4 (blue line), to the model efficient frontier as computed using the macroeconomic and fiscal environments as of the end of 2022Q1 (red line).
- The efficient frontier has moved up (higher cost) and to the right (higher volatility). As we will show below, this is primarily due to the change in the fiscal environment between 2019Q4 and 2022Q1.
- The blue and red dots in the upper right plot represent Treasury's issuance kernel as of 2019Q4 and 2022Q1, respectively. The degree to which issuance lies off the model efficient frontier has remained about the same.
- The graph in the lower right shows the efficient frontier using the macroeconomic environment in 2019Q4, but the fiscal environment from 2022Q1. To do this, we use the debt stock from 2022Q1 shifted back in time 9 quarters and rescaled by nominal GDP, in order to ascertain the effect of having a debt to GDP ratio in 2019Q4 equal to that in 2022Q1. We also use the primary deficit as a percent of GDP from 2022Q1.
- The modified 2019Q4 frontier lies almost on top of the 2022Q1 frontier, implying that most of the difference in the frontiers in the upper chart can be attributed to the shift in the fiscal environment. The remaining distance is due to the difference in the macroeconomic environment.

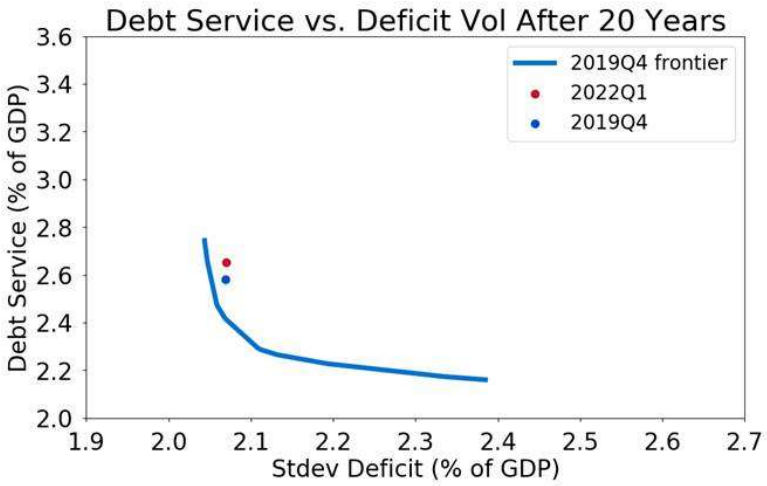


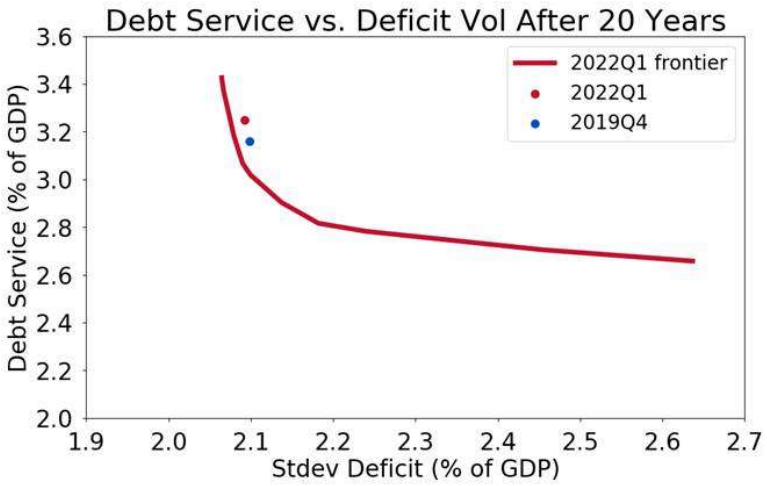


Efficient Frontiers and Historical Issuance

Comparing recent Treasury issuance patterns in differing macroeconomic and fiscal environments

- Next we consider Treasury's current and previous issuance in the same environment. We examine both 2019Q4 and 2022Q1.
- The chart in the upper right displays the efficient frontier as computed in 2019Q4 for the macroeconomic and fiscal environment observed in 2019Q4, and the blue and red dots represent the cost and volatility of holding fixed the issuance patterns used in 2019Q4 and 2022Q1, respectively. The chart in the lower right represents the same analysis performed using the macroeconomic and fiscal environment existing in 2022Q1.
- **The two issuance patterns are close to each other, but in both cases, the modeled cost of the 2022Q1 issuance pattern is judged to be slightly higher than that in 2019Q4, while their risk is quite similar. This is mostly due to the increased issuance in the long end and reduction in Bills and belly issuance, as a percentage of the overall issuance.**
- **Both the 2019Q4 and the 2022Q1 issuance patterns are close to the efficient frontier, particularly the 2022Q1 frontier, but the issuance strategies are near the very steep (risk averse) part of the frontier.**





Insights for Future Issuance

Recommendations from the model

- Although the macroeconomic and fiscal situations have changed significantly since the advent of the COVID-19 pandemic, looking much further out into the future, the fundamental conclusions from the model listed in previous charges have not significantly changed, in large part due to the substantial mean-reverting properties of the model.

- The model continues to favor more belly, Bill, TIPS, and FRN issuance, while decreasing issuance in the longer end.
  - When risk is measured by the variation of the deficit (right chart), increasing TIPS issuance is strictly improving initially, as it lowers expected cost and does not increase risk (hence, it moves the issuance pattern closer to the efficient frontier). Increased belly, Bill, and FRN issuance initially reduce cost with minimal additional risk, but then become more risk additive. These observations are consistent with the comparison of 2019Q4 to 2022Q1 issuance on the previous page.
  - When risk is measured by the variation in funding costs (left chart), expected cost can only be reduced if more risk is assumed. However, that trade-off appears relatively attractive, especially in terms off increased belly issuance.

- While taking the model output into account in its objective of minimizing cost and risk to the US tax payer, Treasury should also consider the benefits of maintaining a regular and predictable issuance strategy and preserving market liquidity across a range of maturity points. Additionally, Treasury should consider the extent to which different models could produce different conclusions.

2022Q1