SHIFTING SUPPLY-DEMAND DYNAMICS OF US TREASURIES

Who will buy the oncoming surge of treasuries? And at what price?

Ramu Thiagarajan, Hanbin Im, Prashant Parab,
Marvin Loh, and Elliot Hentov

August 2024

Contents

1 Introduction

3 Changing holding structure of US Treasuries: Why is it important today?

5 Demand for US Treasuries

7 Supply of US Treasuries

9 Impact of changes in total government debt on investor holdings

12 Estimating yield sensitivity of demand

15 Counterfactual analysis: Yield impact of additional Treasury supply absorption

17 Is the market pricing the effect of the oncoming surge of US Treasury supply?

19 Implications of the shifting demand dynamics of US Treasuries

21 Caveats to our analysis

22 Conclusion

Introduction

The recent surge in — and the expected heightened levels of supply of — US Treasuries have become focal points of discussion among financial industry practitioners and policymakers alike.

The Fed's balance sheet increased from US$4 trillion in February 2020 to around US$9 trillion in April 2022 before settling around US$7.3 trillion as of June 2024. The combination of the Fed's aggressive rate hikes and the reduction of bonds on its balance sheet — a process known as quantitative tightening (QT) — has significantly changed the composition of investors purchasing US Treasuries, shifting from price-insensitive to price-sensitive buyers. Consequently, the price reaction to changes in supply has likely become more elastic.

The drivers of this shift are well known. First, due to QT, the Fed is no longer absorbing US Treasuries into its balance sheet. Second, foreign central banks are buying fewer US Treasuries due to reserve diversification and domestic financial stabilization needs. According to US Treasury International Capital (TIC) system data, foreign official institutions' US Treasury holdings decreased from US$4.2 trillion in Q1 2020 to US$3.8 trillion in Q1 2024.[2] This contrasts with the continuous expansion of their US Treasury holdings from the Great Financial Crisis (GFC) to the onset of COVID-19, during which foreign official institutions' holdings grew from US$2.3 trillion to US$4.2 trillion. This shift in the demand base is meaningful for price discovery in the Treasury market.

Now, juxtapose this shift in demand base with the expected deluge of supply coming into the market. According to the latest Congressional Budget Office (CBO) budget and economic outlook, federal budget deficits are expected to total US$20 trillion over the 2025-2034 timeframe, with federal debt held by the public reaching 116 percent of gross domestic product (GDP) by the end of the period, compared to 99 percent of GDP at the end of 2024. In other words, nearly US$2 trillion of net issuance of Treasuries is likely to enter the market each year for the next 10 years.

The shift in demand base, together with the expected surge in Treasury supply, may potentially result in rising yields. While these forces are likely to push yields higher, the demand for longer-dated fixed income securities has also structurally increased due to demographic forces. Many contend that the demand for fixed-income securities has climbed even further recently as a portion of the working population left the workforce after COVID-19.[3] This demographic shift is likely to lead to a structural increase in demand for Treasury securities, potentially suppressing yields.

With these shifting forces in demand and supply, important questions arise: “How do the changing supply-demand dynamics impact the risk premia for US Treasury securities?” Put differently, “How much additional risk premia is likely needed to entice price-sensitive buyers to clear the additional anticipated supply coming to the US Treasury market?” And, “What are the likely implications of these shifting dynamics for the broader market?”

Research shows that significant changes in US Treasury supply can have pronounced effects on yield spreads, with increased supply linked to elevated yields (Krishnamurthy and Vissing-Jorgensen, 2012; Cebula and Boylan, 2019). The role of the Fed and foreign official purchases is also critical. A slowdown in their purchases is likely to result in a substantial, albeit temporary, increase in US Treasury yields (Beltran et al., 2013).

In this paper, we first explore the changing holding structure of US Treasuries by different investor groups. We then empirically analyze the absorption capacity of different investor types and estimate their yield sensitivity to additional debt purchases. Based on these estimations, we run a counterfactual analysis on the potential increase in supply on the market clearing yield. This approach provides an estimate of the change in risk premia from the expected change in supply-demand dynamics.

Our analysis shows that at the five-year tenor, an additional 95 bps may have to be offered for the market to absorb the additional US$2 trillion expected to be supplied by the Treasury. This is nearly one and a half standard deviations in terms of recent yield volatility. This substantial increase in yield will have broader implications for the credit markets as well as foreign exchange (FX). In fact, scenario analysis shows that fixed income aggregate, investment corporate, and high-yield indices, as well as 60/40 portfolios, will experience meaningful loss, not only from interest rate exposure but also from credit and equity exposures. For example, a typical 60/40 portfolio could experience as much as an 8 percent loss if the additional risk premia needed is as high as 95 bps. We explore some of these implications in the final section of the paper.

Changing holding structure of US Treasuries: Why is it important today?

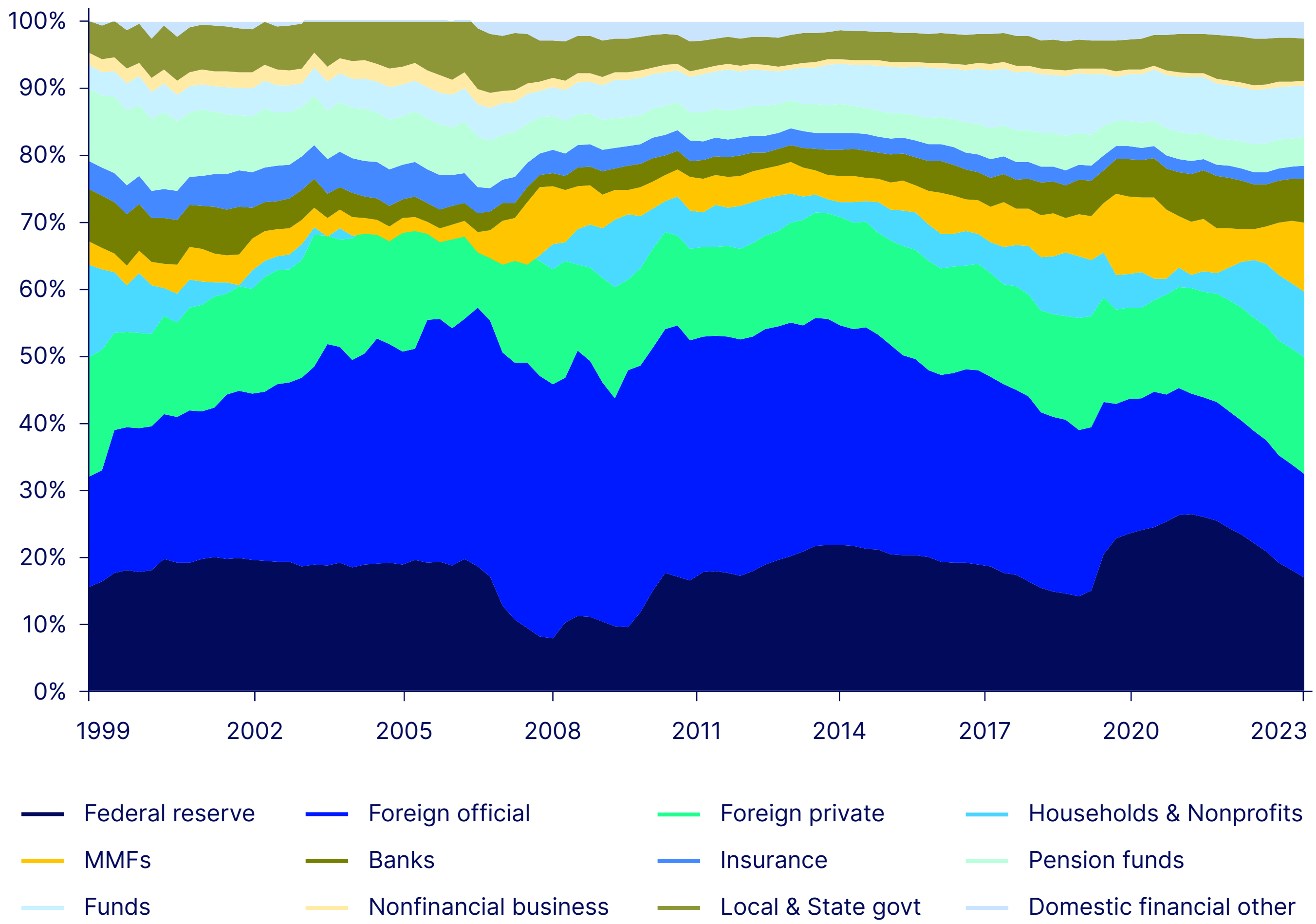
The structural composition of US Treasury holders has undergone significant changes recently, driven by shifts in international monetary policies, geopolitical uncertainties and evolving market dynamics.

Historically, major foreign governments and central banks, particularly those in Asia and oil-exporting countries, have been substantial holders and buyers of US Treasuries. This was primarily due to their strategy of accumulating FX reserves and managing currency values relative to the US dollar. However, recent years have seen a gradual reduction in their share of US Treasuries.

For example, foreign holdings of US Treasuries fell from US$4.2 trillion to US$3.8 trillion from Q1 2020 to Q1 2024. This decline is partially attributable to diversification strategies, changes in trade balances, and a re-evaluation of reserve management practices in response to global financial crises and shifts in US monetary policy (Krishnamurthy and Vissing-Jorgensen, 2012; Arslanalp, Eichengreen, and Simpson-Bell, 2022).

The Fed has been a dominant player in the US Treasury market since the GFC until 2022, primarily through its QE programs to manage interest rates by removing duration from the market. This trend reversed recently when the Fed switched to QT to help control inflation by removing liquidity. Consequently, the share of the Fed's US Treasury holdings began to decline with the launch of its QT program, though its stock still remains high. This shift in the ownership structure can be seen in Figure 1.

Figure 1: US Treasury ownership by different investor groups



Source: Bloomberg

A shift in the ownership structure clearly affects the demand dynamics of US Treasuries, as it influences yields and the cost of borrowing for the US government. Given that US Treasuries provide the benchmark for risk-free securities globally, changing yield dynamics for these debt instruments impact sovereign rates worldwide.

Next, we analyze the changing demand and supply dynamics of the Treasury market.

Demand for US Treasuries

Year-on-year growth rates of investor treasury holdings over the past four years can be found below.[4]

Table 1: Annual growth rate of US Treasury holdings by investor groups

	2020	2021	2022	2023
Households & nonprofits	-22%	-50%	68%	125%
Federal reserve	98%	21%	-5%	-15%
Banks	35%	30%	14%	-10%
Insurers	10%	3%	-10%	11%
Pension funds	2%	9%	-4%	15%
Money market funds	121%	-6%	-34%	14%
Mutual funds & ETFs	2%	22%	-1%	2%
Foreign official	3%	-1%	-10%	-1%
Foreign private	12%	12%	8%	10%

Source: Federal Reserve, US Treasury

Domestic private investors have significantly increased their holdings of US Treasuries since 2022. Households and nonprofits, which include hedge funds, have increased their holdings nearly fourfold from 2021 to 2023, rising from US$572 billion in 2021 to US$2144 billion in 2023. Insurance, pension funds and money market funds (MMFs) have also increased their holdings of US Treasuries in 2023.

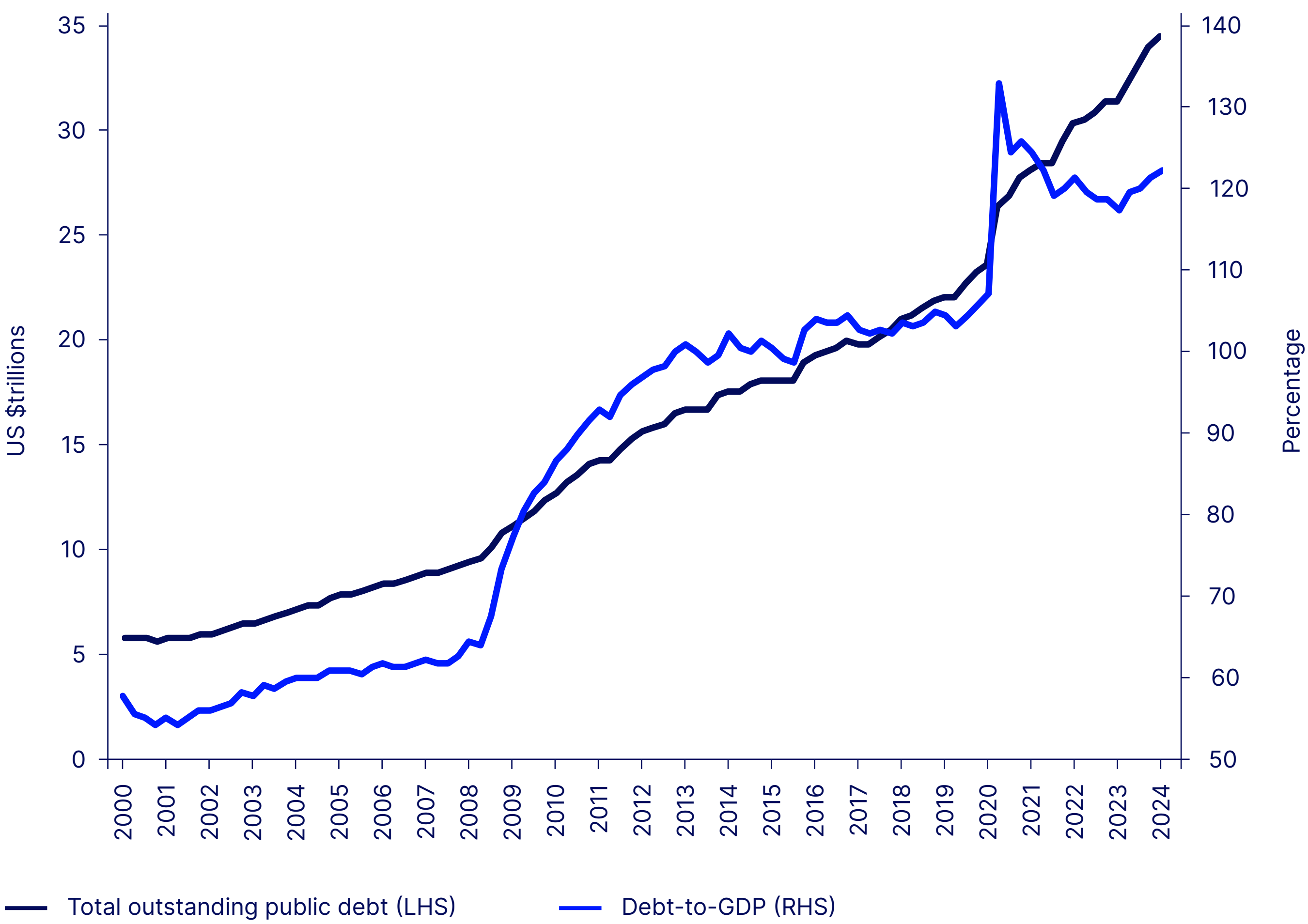
Conversely, the Fed, banks and foreign official institutions have reduced their holdings of US Treasuries throughout 2023. Historically, the Fed and banks have been price-insensitive buyers, with the former consuming duration pursuant to monetary policy and the latter buying duration for reserve requirements and other regulatory needs. In summary, there has been a significant increase in demand for US Treasuries by price-sensitive investors and a reduction in demand from price-insensitive buyers like the Fed and foreign official institutions since 2022.

Supply of US Treasuries

The supply of outstanding government debt has increased substantially since the GFC, growing roughly fivefold from US$5.5 trillion in September 2007 to about US$25 trillion in March 2024. Massive fiscal expansion due to COVID-19 was one of the major contributing factors to this significant uptick in government debt.

The debt-to-GDP ratio increased from about 65 percent in 2007 to over 120 percent by the first quarter of 2024. Figure 2 shows the path of the increasing overall debt as well as a simultaneous rise in the debt-to-GDP ratio.[5]

Figure 2: US government debt and Debt-to-GDP ratio



Source: Macrobond

The increase in debt during a period of rising interest rates has resulted in higher debt servicing costs for the Treasury Department. From fiscal year Q1 2021 to Q1 2024, the total US Treasury outstanding increased from US$28 trillion to US$34.5 trillion[6], and net interest outlays rose from US$352 billion in FY2021 to US$658 billion in FY2023, increasing from 13 to 31 percent of the Treasury budget.

Further, in addition to the existing stock of debt that needs to be serviced, the CBO notes that the current primary deficit (that is, budget deficit before interest payments) is running at 3.9 percent of GDP, the highest in the G7. These imbalances are being generated during a non-recessionary period and are well ahead of the 50-year average of -1.6 percent in a non-recessionary period. Assuming a fiscal consolidation that would bring the primary deficit halfway to historical norm (2.7 percent by 2034) implies an additional US$2 trillion will need to be issued every year for the next 10 years. This supply boom will invariably increase the risk premia for these securities.

This change in the supply-demand dynamics brings us to the important question of how it will impact US Treasury yields. In the remainder of this paper, we aim to address three key questions:

1. What has been the impact of the changing balance sheet structure on the relative appetite for Treasuries among investor groups across different Treasury policy regimes? Our hypothesis is that as the balance sheet grew, the marginal buyer was the price-insensitive buyer, and this reversed as the balance sheet shrank due to QT.
2. What is the yield elasticity of demand for US Treasuries among different investor groups?
3. Given the projected supply of US Treasuries in 2024 and their changing holding structure, what will be the impact on the yield for all the supply to be absorbed?

Impact of changes in total government debt on investor holdings

We first analyze the impact of changes in total government debt on investor holdings by various types of investors across different Treasury policy regimes.

Naïve empiricism suggests that as the balance sheet expanded, price-insensitive buyers increased their holdings. This was the QE effect. However, the opposite was true during QT.

To measure the responsiveness of different groups of buyers to changing levels of debt, we run a regression model for each investor group along the lines of Fang et al. (2023). Since the responsiveness of demand is likely to be different across monetary policy regimes, we need to capture this variable in our analysis. Our analysis considers three different periods: (i) pre-QE, from Q1 2000 to Q4 2008, (ii) QE, from Q1 2009 to Q4 2021, and (iii) post-QE, from Q1 2022 to Q1 2024.[7]

Equation (1) specifies the change in holding of the different investor groups denoted by ΔH^i_t as a function of the changes in the debt outstanding, ΔD_t, obtained from the Fed's Flow of Funds data for Treasury holdings of different investor groups.[8]

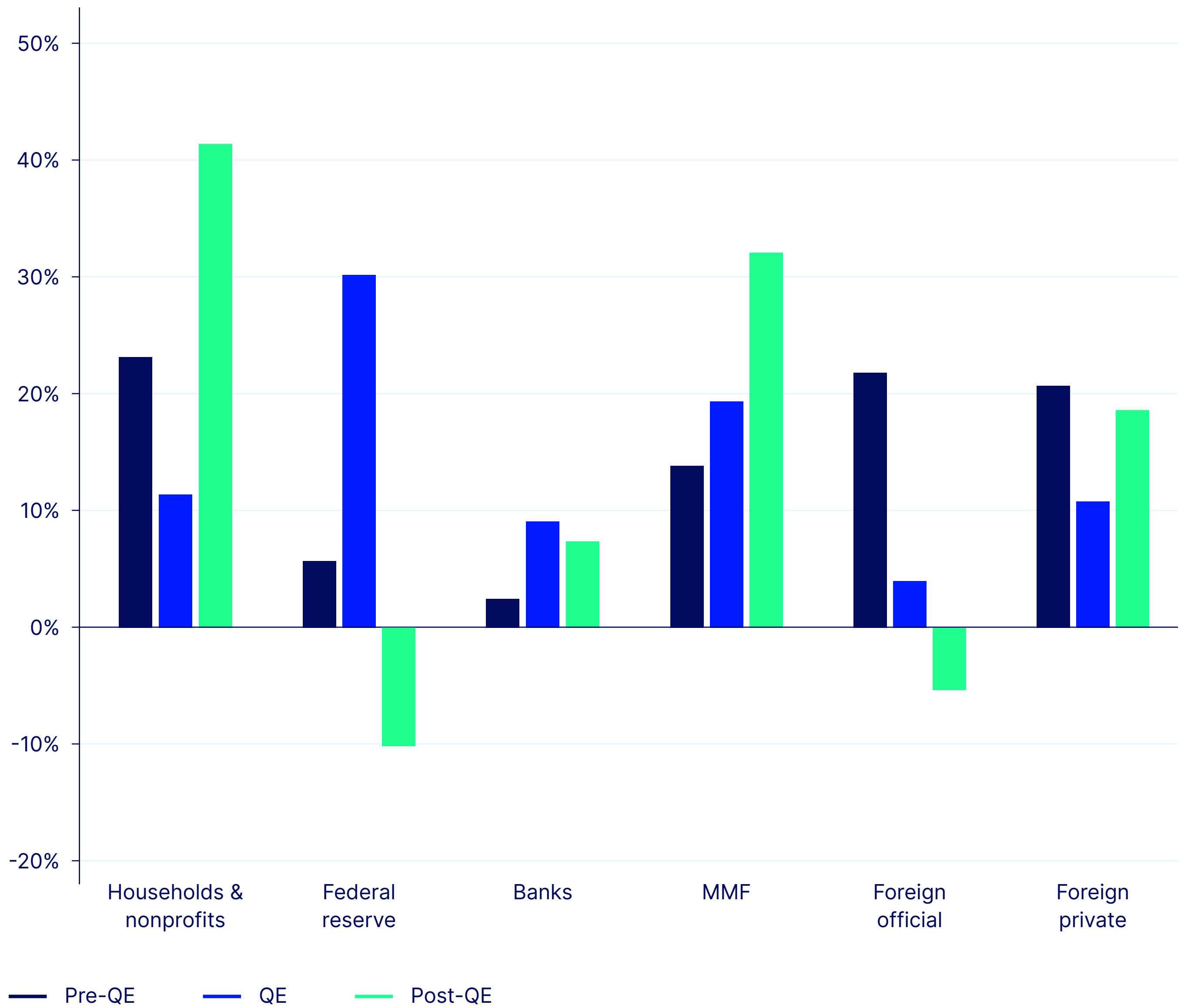
To isolate the responsiveness across different regimes, we use interaction dummy variables similar to Eren et al. (2023).[9]

$$\frac{\Delta H^i_t}{D_{t-1}} = \alpha^i + (\gamma^i_{pre-QE} \times dummy^i_{pre-QE} + \gamma^i_{QE} \times dummy^i_{QE} + \gamma^i_{post-QE} \times dummy^i_{post-QE}) \frac{\Delta D_t}{D_{t-1}} + u^i_t \quad (1)$$

In Equation (1), H^i_t is the total face value of US Treasuries held by investor group i at time t, D_t is the total amount of US Treasury outstanding, and $dummy^i_{period}$ is a dummy variable that takes the value 1 for the specified period and 0 otherwise. Each γ^i_{period} represents the marginal holding response of investor group i to changes in the total US Treasury outstanding during the specified periods (pre-QE, QE, and post-QE). Finally, u^i_t represents the residual term of the regression equation for investor group i at time t, and α^i is the regression intercept term for each corresponding investor group.

The results of the analysis are specified in Figure 3 below.[10]

Figure 3: Marginal responses of investor groups to increases in US Treasury supply by period



Source: Authors' Estimates

Note: We include only those holders whose marginal response in at least one of the three periods of analysis crosses an absolute value of 5 percent.

Figure 3 depicts the marginal responses of different investor groups to the changes in US Treasury supply across the three periods. Before the QE program, foreign investors — both official and private — accounted for more than 40 percent of marginal absorption, while the Fed absorbed less than 10 percent. This changed dramatically with QE, where the Fed became the largest marginal absorber, with an absorption rate exceeding 30 percent. Consequently, foreign investors' marginal response declined during this period.

With the tapering and end of QE, the Fed's marginal response turned negative. Similarly, foreign officials' marginal response also turned negative as major central banks reduced their balance sheets and reserves. These results make intuitive sense.

Our analysis shows that private investors, particularly households and nonprofits, as well as foreign private investors, significantly increased their marginal response post-QE as official institutions decreased theirs. MMFs consistently increased their marginal response through all periods, highlighting their growing role as marginal absorbers. This is partly driven by demographic demand and partly by risk aversion, as investors seek to park assets in short-term instruments while inflationary pressures and monetary policy normalize. Thus, as expected, our descriptive analysis illustrates the shifting demand for US Treasuries from official institutions to private investors in recent years.[11]

While the change in marginal response of different investors largely aligns with expectations, understanding the changes in yield sensitivity of these different investor groups over time is crucial. What are the implications of these shifting supply-demand dynamics on yield? We analyze this question next.

Our descriptive analysis illustrates the shifting demand for US Treasuries from official institutions to private investors in recent years.

Estimating yield sensitivity of demand

To estimate the yield sensitivity of demand for US Treasuries, we follow the popular demand system approach to asset pricing motivated by Koijen and Yogo (2019).

In our model, the investor chooses to invest in Treasuries as part of their entire debt portfolio.[12] The variable of interest is $H^i_t / H(0)^i_t$ wherein H^i_t is the US Treasury holding and $H(0)^i_t$ is the value of debt securities other than US Treasuries (outside securities).

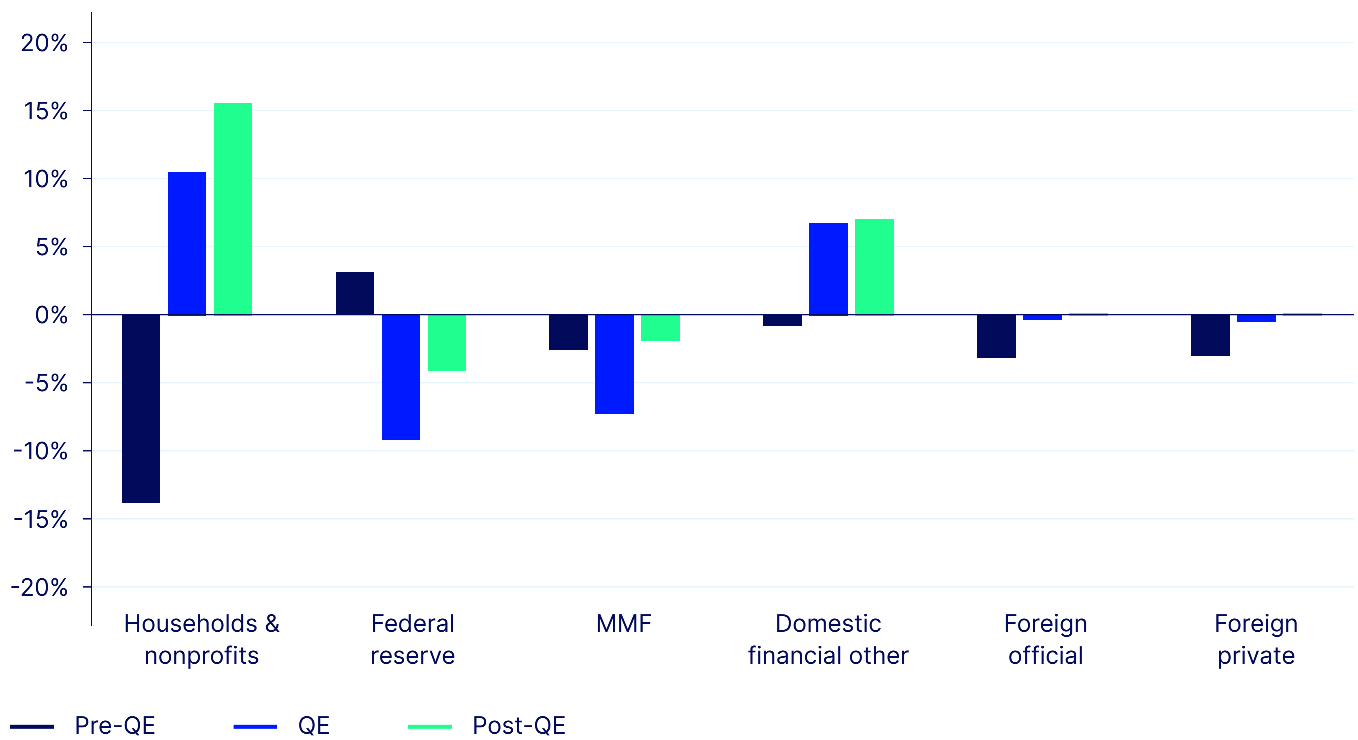
We model the portfolio decision to invest in US Treasuries — specified as $H^i_{t-1} / H(0)^i_t$ — as a function of three covariates. First, the existing stock of holdings in US Treasuries captured by the lagged values of $H^i_{t-1} / H(0)^i_{t-1}$, which serves as a proxy for persistence in demand (Norges Bank Investment Management (NBIM), 2024). Second, the yield on US Treasuries, for which we use the five-year zero-coupon bond yield[13] as a proxy for the demand across the entire yield curve. The key metric of interest is β^i_1, which represents the sensitivity of holdings as a function of yield. Third, a vector of macro-economic variables such as GDP growth and inflation, which impact the risk premia for US Treasuries. This is specified in Equation (2) below.

$$\ln\left(\frac{H^i_t}{H(0)^i_t}\right) = \alpha^i + \beta^i_0 \ln\left(\frac{H^i_{t-1}}{H(0)^i_{t-1}}\right) + \beta^i_1 y_t + \beta^i_2 \boldsymbol{X}_t + \epsilon^i_t \qquad (2)$$

In Equation (2), H^i_t is the total face value of US Treasuries held by investor group i at time t, $H(0)^i_t$ is the value of debt securities other than US Treasuries investor i hold at time t[14], y_t is the five-year zero-coupon US Treasury yield, $\boldsymbol{X}_t$ is a vector of macroeconomic characteristics such as GDP growth and inflation that determine risk premia. Specifically, we use the quarter-on-quarter annualized real GDP growth rate, year-over-year core personal consumption expenditure (PCE) inflation, and the logarithm of the real effective exchange rate (REER). ϵ^i_t represents residuals of the regression equation that contain latent demand.

Directly conducting a linear regression analysis with Equation (2) may lead to spurious estimates of yield sensitivity since yield and residuals are likely endogenous. To address this, we estimate $\tilde{y}$ determined primarily by macroeconomic factors. This estimated $\tilde{y}$, called the "instrumental variable," is then used in the empirical estimation of Equation (2). The details of the instrumental variable are provided in Appendix A.

Figure 4: Time-varying yield semi-elasticity of demand for select investor groups



Source: Authors' Estimates

Using the estimated instrumental variable, which is exogenous to residuals (as explained in Appendix A), we can estimate the yield sensitivity of demand for US Treasury holdings for each investor group, β^{i}_{1}.[15]

Importantly, we estimate this for the three regimes noted earlier (pre-QE, QE and post-QE) using our dummy variable method. We are most interested in the yield sensitivity variable (β^{i}_{1}) in the post-QE period. Figure 4 plots the coefficients for select investor groups in each period.[16]

A positive coefficient in Figure 4 means that the corresponding investor group, on average, demands a higher yield to add to their US Treasury holdings. Put differently, their demand for US Treasury exhibits an upward sloping curve with respect to yield,[17] meaning the US Treasury will have to offer a higher yield to persuade this group to buy Treasuries. Further, a higher magnitude of the coefficient indicates that the respective investor's demand for Treasuries is more elastic with respect to changes in yield.

As expected, most investor groups — except the Fed, state and local governments, and MMFs — have positive coefficients on yield, reflecting that their demand is price-sensitive. In particular, households and nonprofits saw a sharp increase in price sensitivity post-QE. This is logical as this group is historically the most price-sensitive. Other domestic financial investors have also become yield-sensitive with the onset of QE. On the other hand, the Fed's demand for securities is not sensitive to yield. Before the launch of the QE program, the Fed's yield sensitivity of demand was actually positive but has reversed since then.

Unlike other private investors, MMFs in our analysis exhibit a downward sloping demand curve with respect to yield. This can be attributed to several factors:

1. **Asset Allocation:** From an asset allocation perspective, MMFs absorb assets as investors adjust their asset allocation model concerning risk assets. The flow of assets into MMFs can be driven more by risk aversion, making their relationship with yield somewhat insensitive.
2. **Direct Market Access:** Kotomin et al. (2014) argue that investors with direct access to short-term fixed-income markets may invest in those securities directly during times of rising interest rates rather than in MMFs, and vice versa, due to MMFs' use of the "amortized cost" method of valuation.[18] This partly explains why MMFs do not exhibit an upward-sloping demand curve for yield.
3. **Investment Preferences:** Depending on the structure of the MMFs, some may prefer to invest in repurchase agreements (repos) rather than Treasuries, further weakening the relationship between MMFs' demand for Treasuries and yield (Doerr et al. 2023).

Our analysis confirms that the demand dynamics for US Treasuries has indeed shifted from yield-insensitive investors to yield-sensitive ones. In terms of magnitude, households and nonprofits are the most sensitive to yield, followed by other domestic financials, including brokers and government-sponsored entities. While foreign private investors exhibit a positive coefficient recently, they are less elastic than the former groups.

With these results, we can conduct a counterfactual analysis to answer the question: "How much additional yield will be needed by these yield-sensitive investors to absorb the additional US Treasury supply projected to flood the market?"

Counterfactual analysis: Yield impact of additional Treasury supply absorption

The CBO estimates the US budget deficit will be approximately US$2 trillion by each year for the next 10 years. Given both the Fed's and foreign official institutions' declining appetite for US Treasuries, the key question is how much yield change is needed to absorb this additional supply.

What will be the yield sensitivity of investors when these added Treasuries enter the market? This is unknown, but we can approximate it by using the yield sensitivity of demand during the post-QE period.

We assume that the trend observed over the past couple of years — zero participation by the Fed and reduced participation by foreign official institutions — will continue over the analysis period.[19] In our analysis, most of the additional supply is absorbed by households and nonprofits, followed by MMFs and foreign private investors. Given the yield elasticity of demand for these different groups, it is relatively straightforward to calculate how much additional yield will be required by these groups to uptake US$2 trillion in additional supply.

To estimate the hypothetical change in yield to absorb the additional supply, we need two inputs: (a) the marginal response of investors for additional debt issuance by the CBO (or the quantity that each investor is willing to uptake for each dollar of debt issuance), and (b) the additional yield required to entice investors to uptake the issuance (or the price at which they are willing to uptake the issuance). The former (a) can be approximated by the results of our Equation (1), and the latter (b) by the results of our Equation (2).

To calculate the aggregate yield impact required for the absorption of additional Treasury supply in the economy, we first calculate the weighted-average semi-elasticity of demand with respect to yield from Equation (2), using the marginal response estimated in Equation (1) as the weight.

Then, we take the inverse of the weighted-average semi-elasticity of demand to get the respective yield impact.[20]

$$dy = \sum_{i=1}^{N} \frac{\gamma i}{\beta^{i}} \qquad (3)$$

Using the estimates from our yield sensitivity analysis, we find that the yield would need to increase by approximately 95 bps at the five-year tenor for investors to absorb the total US Treasury supply of US$2 trillion, ***ceteris paribus***[21]. This result is roughly in line with that of NBIM (2024), which showed that US$1.4 trillion of additional US Treasury supply can lead to an increase in private investor US Treasury holdings of 7 percent and average yield impact of 83 bps. Eren et al. (2023) also estimated that a reduction of the Fed's balance sheet through the QT process worth US$1.8 trillion can lead to a 100-bps increase in eight-year bond yields.

An additional 95 bps of yield at the five-year tenor is a significant increase in cost and represents nearly one-and-a-half standard deviations of historical realized volatility in the five-year yield from current levels. An increase in the US Treasury yield has far-reaching implications in other markets, including equities, credit and emerging market securities. In the next section, we briefly discuss whether the market is pricing this effect from the oncoming surge of US Treasury supply.

95 bps

An additional yield at the five-year tenor is a significant increase in cost and represents nearly one-and-a-half standard deviations of historical realized volatility in the five-year yield from current levels

Is the market pricing the effect of the oncoming surge of US Treasury supply?

Results from our previous analysis imply that a higher risk premium will be required for the market to absorb the anticipated surge in US Treasury supply. It is reasonable to ask, "Is the market currently pricing in any of these effects?"

The effect of the surge in Treasury supply, combined with shrinking price-insensitive demand, is difficult to measure — even in one of the deepest and most liquid markets, such as US Treasuries. In one of our earlier reports, we looked at clues to this effect in the 5y5y Treasury swap market (State Street Global Markets, 2024b). The 5y5y swap market reflects expectations for the yield on the 5-year tenor five years hence.

The 5y5y instrument is a reasonable proxy for assessing "the steady state outlook across economic cycles and the associated levels of compensation investors will require." However, the 5y5y swap is not perfect, as it reflects the effect of various market assessments, including political risk, safe-haven demand from crises and more. Thus, inferences drawn from the 5y5y swaps should be understood as reflecting multiple factors beyond those driven by the supply surge.

A comparison of the current 5y5y forward interest rate swap to the pre-pandemic average during the 2015-2019 period shows that the market is pricing around 130 bps higher than the pre-pandemic regime. This is broadly in line with our model prediction of 95 bps, but there is a notable difference. Our models reflect a risk premium of 95 bps over the next year, whereas the 5y5y projects over a 5-year horizon. The larger risk premium arises from a combination of multiple risk factors over this horizon, including the increasing interest outlays of the US government and concerns about fiscal profligacy by a new administration.

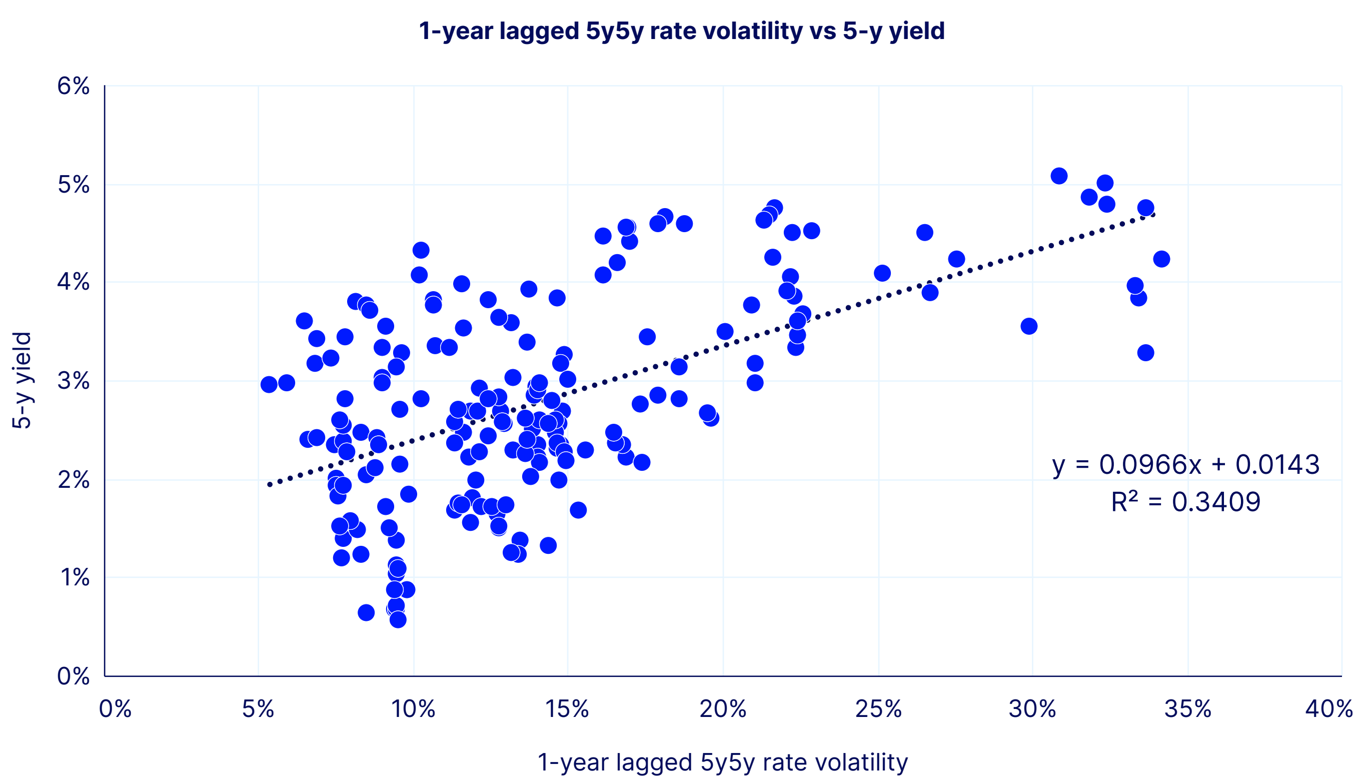
We believe that much of the expected increase in the risk premium should be attributed to term premia rather than expected short rates. Term premia represent compensation for a variety of risk factors surrounding rates, including inflation, monetary policy, policy uncertainty and economic growth. With the Fed Fund rates expected to ease following anticipated Fed cuts, our projections of risk premia can be attributed almost entirely to higher-term premium.

As rates are expected to go up, so does the volatility of rates. Recently, we have seen increasing volatility in the 5y5y swap contracts. Research shows that the volatility of 5y5y contracts is a leading indicator of future rates. To test this, we analyzed the relationship between 5-year rates and 1-year lagged volatility of 5y5y contracts. Our findings, shown in Figure 5, clearly demonstrate a positive relationship between 5y5y interest rate volatility and future yields.

Specifically, our analysis shows that a 1 percent increase in volatility raises 5-year rates by 9 bps.

Based on our analysis, the market is likely to demand a much higher risk premium to absorb the extraordinary increase in supply. This premium is primarily a term premium, reflecting multiple uncertainties that markets need to be compensated for in the process of absorbing the swell in supply. Rate derivative markets clearly reflect this need for higher risk premia arising from the changing supply-demand dynamics through both the level of 5y5y and the predictive power of volatility metrics.

Figure 5: Relationship between 5y5y interest rate volatility and 5-year yield



Implications of the shifting demand dynamics of US Treasuries

In this section, we briefly discuss the implications of the shifting demand dynamics for US Treasuries and the resulting rise in yields. As noted earlier, an additional 95 bps of yield at the five-year tenor represents a significant increase.

A meaningful rise in Treasury yields has broader implications for credit, equities and other higher-risk assets. These implications are harder to assess as they depend on the covariance of these assets with Treasuries at the time of the shock. However, scenario analysis can provide insight into potential spillover effects.

Using a robust risk model, we conducted a scenario analysis on a set of fixed-income indices and a 60/40 portfolio, assuming a 95-bps increase in the five-year yield.[22] In this scenario, we find that the aggregate fixed-income index declines by 7.4 percent, the investment-grade corporate index by 8.2 percent, and the high-yield index by 4.7 percent. These are all multi-standard deviation loss realizations. While the loss from the interest rate curve due to the yield increase is expected, the concomitant widening of the credit spread is notable. Moreover, a 60/40 portfolio comprising US equity and US aggregate fixed-income indices loses 8 percent, with 5 percent from the equity portion. Thus, this shifting landscape necessitates a recalibration of investors' risk management and investment strategies.

Our analysis is based on several assumptions, including the choice of the risk model, factor models, and look-back periods. It is not meant to be an exhaustive study of the shift in risk premia, but rather to provide a glimpse of the potential effects under reasonable assumptions using a robust risk model.

Increased sensitivity of US Treasuries to market swings and macroeconomic data may also challenge the traditional view of US Treasuries as safe-haven assets. As the market becomes dominated by price-sensitive buyers and their yield sensitivity grows, managing downturns becomes more challenging as the yield floor for Treasury absorption may rise. This increases the cost of hedging during downturns. Thus, investors will need to employ more sophisticated hedging techniques and remain nimble in response to fluctuating yields and market conditions.

What is likely to happen to volatility in the US Treasury market? As price-sensitive buyers become more dominant in absorbing US Treasury supply, the market may experience increased volatility and higher yields. Unlike price-insensitive buyers, such as the Fed and foreign official institutions that typically purchase US Treasuries for policy reasons rather than yield, price-sensitive buyers are more likely to respond to evolving market conditions and economic data, thereby increasing volatility in US Treasury prices. As volatility increases, investors will likely demand a higher term premium.

This, in turn, raises the cost of borrowing for the US government, making debt management more challenging and potentially increasing the federal budget's interest expenses. This is particularly costly given the projected increase in US fiscal deficits.

Lastly, from a monetary policy perspective, this shifting debt demand environment can potentially limit the effectiveness of the Fed's policy. As noted by Krishnamurthy and Vissing-Jorgensen (2012), a marketplace influenced more by price-sensitive buyers could diminish the effectiveness of the central banks' maneuvers of long-term interest rates through Treasury purchases, particularly during economic downturns where robust monetary intervention is crucial. This is especially true in the current situation, where the Fed has a bloated balance sheet, unlike during previous QE periods.

As price-sensitive buyers become more dominant in absorbing US Treasury supply, the market may experience increased volatility and higher yields.

Caveats to our analysis

Naturally, any analysis relying on model-based forecasts must acknowledge the conditions under which the forecasts may prove wrong. We recognize at least three reasons why our model forecasts may not materialize.

First, we may be underestimating the demand for US Treasuries driven by demographic changes. Long COVID is known to have affected nearly 18 million people in the US[23], accelerating their exit from the workforce and increasing their demand for risk-free assets. This additional demand for risk-free assets due to COVID may very well absorb the additional supply.

Second, there may be new sources of US Treasury demand in the future, such as the growth in digital assets and asset tokenization that rely on stablecoins, which are typically composed of US Treasuries. However, stablecoins operate similarly to MMFs, and therefore exhibit some price-sensitivity in their asset allocation.

Third, increased geopolitical risk and fragmentation can heighten demand for safe-haven assets. In this scenario, US Treasuries are likely to be the primary beneficiary, as there is no real alternative to them in the fixed-income market, just as there doesn't seem to be an alternative to the US dollar as a de-facto hegemonic currency, as discussed in Thiagarajan et al. (2023).

Finally, for ease of modeling, we use the standard ***ceteris paribus*** condition — meaning that we kept all other variables constant while toggling only the supply variable. In a dynamic world with many moving parts, this assumption, while common in model building, may prove overly optimistic. Thus, realized yields may turn out to be very different if these modeling conditions are violated in reality.

These caveats notwithstanding, the shift from a market dominated by price-insensitive buyers to one driven by price-sensitive buyers fundamentally alters the price discovery process for all stakeholders. This shift is already evident in the rate derivatives market, where an increase in risk premium is being priced in by market participants.

Conclusion

The projected swell in US Treasury supply and the evolving structure of US Treasury holdings have raised concerns about who will absorb this growing debt. We find that there has been a substantial increase in US Treasury holdings by price-sensitive buyers recently, along with a persistent decline in holdings by price-insensitive buyers, such as the Fed and foreign official institutions.

By estimating the time-varying marginal absorption of additional US Treasury supply across different investor groups, along with their respective yield sensitivity of demand, we determined that yields would need to rise by approximately 95 bps to absorb the projected US$2 trillion in additional Treasury supply. Over 60 percent of this absorption is expected to come from US private investors, namely households and nonprofits, as well as foreign private investors. Given its current monetary policy stance, the Fed is unlikely to play an active role in absorbing this supply in the near future.

The decreased participation of official institutions and the resulting shift toward price-sensitive buyers have significant implications for the US Treasury market, monetary policy and investment strategies. These include increased market volatility, a higher term premium and potentially reduced effectiveness of the Fed's monetary policy. Investors will need to recalibrate their risk management strategies and adopt more sophisticated hedging techniques to navigate this new environment.

Our paper seeks to contribute to the important discussion on the implications of this unprecedented increase in US Treasury supply, particularly in a market that has been fundamentally transformed by rising inflation and the end of liquidity injections by central banks. This evolving landscape compels a re-evaluation of how investors and policymakers navigate a new era of heightened uncertainty, structural shifts and altered processes of price discovery.

Acknowledgements

The authors would like to thank Eric Garulay and Michael Metcalfe for productive discussions and insightful comments on earlier versions of this paper.

Endnotes

1. This was measured at the 5-year point of the yield curve.

2. As of Q1 2024, foreign official institutions' share of US Treasury holdings has declined to 16 percent, down from an average of 28 percent during the 2015-2019 period. Although the TIC data does not differentiate between official and private holdings for each country, it does show that Japan's US Treasury holdings dropped from US$1.3 trillion to US$1.18 trillion over the same timeframe. China's holdings exhibited a similar downward trend in the TIC data; however, obtaining a complete picture of China's Treasury exposure requires a more comprehensive assessment due to their use of offshore custodians, particularly in Europe. Even if China's overall Treasury exposures were to remain flat, Chinese demand via state banks and state-owned enterprises is more price-sensitive compared to the outright reserve management by the People's Bank of China (PBOC).

3. A recent study by the US Chamber of Commerce finds that the United States is missing about 1.7 million workers from its labor force compared to February 2020 due to early retirements, an aging workforce, and other demographic shifts. Understanding America's Labor Shortage | U.S. Chamber of Commerce (uschamber.com)

4. We use average quarterly holdings in a given year to calculate the year-on-year growth rate.

5. Outstanding government debt and debt-to-GDP ratio each have a significantly high correlation coefficient — 0.96 (since 1996) and 0.95 (since 2008), respectively.

6. This combines both US Treasury securities marketable to the public and those that are non-marketable.

7. Pre-QE and QE periods are divided as per the literature. The post-QE period is chosen from Q1 2022 to coincide with the tapering of asset purchases by the Fed.

8. The Fed's Flow of Funds data reports the holdings of Treasury securities for different investors groups at market value. To adjust for valuation effects, we remove the impact of price changes on each period's holdings using the 5-year zero-coupon yield estimated from the Kim and Wright model, sourced from FRED. We use five years as the average maturity of Treasury holdings, given that the average maturity of the total US Treasury outstanding has historically been 60 months.

9. An important caveat is that the residual term is the same across all three regimes. While this assumption does not lead to adverse econometric implications, conducting the analysis separately for all three regimes, albeit ideal, is not feasible due to the limited data.

10. The underlying assumption for this analysis is that the total supply of outstanding US Treasury equals the sum of demand by each investor group, i.e., ${\sum^I}_{i=1} {H^i}_t = D_t$. This assumption is necessary to ensure marginal responses are based on market-clearing conditions.

11. We also directly measured the change in US Treasury holding of all investor groups as a share of changes in the total US Treasury outstanding. The results are largely consistent with the marginal response coefficients estimated.

12. The model used in this analysis assumes that the decision to invest in equity or any risk asset is independent of the decision to invest in debt securities.

13. We use the five-year tenor for convenience of estimation. The results are expected to be qualitatively similar for other tenors.

14. Direct data for the outside assets is not always available. As a result, some studies use different proxies to designate the same. Eren et al. (2023) use proxy variables like VIX (in logs) and German government bond yields. Koijen et al. (2021) use the US Treasury yield to proxy outside investment opportunities available to euro-area investors,

which can include corporate bonds, asset-backed securities and covered bonds. The Fed's Flow of Funds data contains information about different investors' US Treasury holdings as well as other assets in their respective portfolios. We use this data directly, particularly the financial holdings of debt securities for each investor, to account for outside assets. One caveat is that we assume investors make allocation decisions within the realm of debt securities with a fixed cross-asset allocation target. Additionally, we acknowledge the limitation of outside asset data for foreign investors, as the Fed's Flow of Funds data only contains US-domiciled debt securities that foreign investors hold.

15. Post-estimation diagnostics for the instrument validity indicate it to be appropriate for the analysis.

16. The analysis includes a total of 12 investor groups. However, we present only 6 key investors in Figure 3, which have significant marginal responses and/or high yield sensitivities.

17. This means that these investors have a downward-sloping demand for US Treasuries with respect to price, given the inverse relationship between bond price and yield.

18. Under the amortized cost valuation method, which MMFs employ to maintain a constant share value, securities are valued at acquisition cost rather than market value, and interest earned on each security is accrued uniformly over the remaining maturity of the purchase. In other words, if the current yield is higher than previously, investors can earn a higher return by directly investing in those securities rather than in MMFs.

19. Unlike other studies in the literature, whose datasets end in 2022 or earlier, we do not derive the US Treasury supply forecasts based on some underlying model or analysis. Instead, we use the quarterly CBO forecasts to get reliable estimates. Therefore, we do not conduct a counterfactual analysis based on multiple US Treasury supply amounts, thereby avoiding QE/QT scenarios in the counterfactual analysis.

20. A detailed derivation of this counterfactual can be seen in Appendix B.

21. This means that the estimated change in yield assumes other macroeconomic variables remain constant. That is, the actual change in yield may differ from estimates depending on changes in macroeconomic variables.

22. We also adjusted the ten-year yield to 5.75 percent — which corresponds to the midpoint of our Macro Strategy team's assessment range — considering the increase in US Treasury supply.

23. https://www.theguardian.com/world/2024/mar/15/long-covid-symptoms-cdc

References

Beltran, D., Kretchmer, M., and Marquez, J. 2013. "Foreign Holdings of U.S. Treasuries and U.S. Treasury Yields." International Finance Discussion Papers, Board of Governors of the Federal Reserve System

Cebula, R. and Boylan, R. 2019. "An empirical analysis for the US of the impact of federal budget deficits and the average effective personal income tax rate on the ex post real interest rate yield on ten-year Treasuries". PSL Quarterly Review, Economica civile, Vol. 72(288), pp 41-52

Doerr, S., Eren, E., and Malamud, S. 2023. "Money Market Funds and the Pricing of Near-Money Assets". BIS Working Papers No. 1096

Eren, E., Schrimpf, A., and Xia, F. 2023. "The demand for government debt". BIS Working Papers No. 1105

Fang, X., Hardy, B., and Lewis, K. 2023. "Who Holds Sovereign Debt and Why It Matters". NBER Working Paper 30087. National Bureau of Economic Research

Federal Reserve (TBAC). 2023. "Outlook for demand for US Treasuries".

Hoek, J., Yoldas, E. and Kamin, S., 2021. "Are Rising US Interest Rates Destabilizing for Emerging Market Economies?". Federal Reserve

Koijen, R.S., Koulischer, F., Nguyen, B. and Yogo, M., 2021. Inspecting the mechanism of quantitative easing in the euro area. *Journal of Financial Economics, 140*(1), pp.1-20.

Koijen, R. and Yogo, M. 2019. "A Demand System Approach to Asset Pricing". NBER Working Paper 21749. National Bureau of Economic Research

Kotomin, V., Smith, S.D. and Winters, D.B., 2014. Interest-rate and calendar-time effects in money market fund and bank deposit cash flows. Journal of Economics and Finance, 38, pp.84-95.

Krishnamurthy, A. and Vissing-Jorgensen, A. 2012. "The Aggregate Demand for Treasury Debt". Journal of Political Economy, Vol. 120(2), pp. 233-267

Levy, M. 1981. "Factors affecting monetary policy in an era of inflation". Journal of Monetary Economics. Vol. 8(3), pp. 351-373

Norges Bank Investment Management. 2024. "Investor demand and government bond pricing". Discussion Note #1

Rhee, D. 2012. "Effects of U.S. Unconventional Monetary Policy and Implications for QE3". World Economy Brief 12-4, Korea Institute for International Economic Policy

State Street Global Markets. 2024a. "Death, taxes, and bigger deficits".

State Street Global Markets. 2024b. "When the dust settles: Clues from 5y5y's"

Thiagarajan, R., Lacaille, R.F., Hurd, A., Metcalf, M., and Im, H. 2023. "Is US Dollar Dominance Dented?". State Street

Wieladek, T. 2024. "Quantitative easing generates more inflation than conventional monetary policy". CEPR.

Wooldridge, P. 2006. "The Changing Composition of Official Reserves". BIS Quarterly Review

Appendix

Appendix A: Demand Equation and Sensitivity Analysis

We follow the demand system approach postulated by Koijen and Yogo (2019) in analyzing the demand for US Treasury securities. In the following equation, we formulate the optimal US Treasury holdings for an investor group as a ratio of outside debt securities that is an exponential function of its yield and a vector of macroeconomic factors:

$$\frac{H^i{}_t}{H(0)^i{}_t} = \exp\left(\beta^i{}_1 y_t + \beta^i{}_2 \boldsymbol{X}_t\right) \varepsilon^i{}_t \qquad \text{(A1)}$$

where $\varepsilon^i{}_t$ is the latent demand.

Writing this in a regression format with $\ln(H^i{}_t)$ as the dependent variable and the lagged ratio of holdings as one of the explanatory variables, we get:

$$\ln(H^i{}_t) = \alpha^i + \beta^i{}_0 \ln\left(\frac{H^i{}_{t-1}}{H(0)^i{}_{t-1}}\right) + \beta^i{}_1 y_t + \beta^i{}_2 \boldsymbol{X}_t + \beta^i{}_3 \ln H(0)^i{}_t + \eta^i{}_t \qquad \text{(A2)}$$

where $\eta^i{}_t = \ln(\varepsilon^i{}_t)$

To construct the instrumental variable, we proceed with the assumption that US Treasury supply and demand clear the market. This condition can be written in equation form as follows:

$$D_t = \textstyle\sum^I{}_{i=1} H^i{}_t \qquad \text{(A3)}$$

In Equation (A3), $H^i{}_t = H_t{}^{m,i} / P_t$ is the face value of the investor holdings and $H_t{}^{m,i}$ is its market value. P_t is the price of the zero-coupon yield given by $P_t = (1 + y_t)^{-T}$, where T is the maturity of the zero-coupon yield.

We next derive the market values of investor holdings as a share of GDP by dividing the US Treasuries at market values with nominal GDP, as follows:

$$\frac{P_t D_t}{Y_t} = \textstyle\sum^I{}_{i=1} \frac{H_t{}^{m,i}}{Y_t} \qquad \text{(A4)}$$

We then estimate the market value of the holdings as a share of GDP using the following equation:

$$\boldsymbol{h}_t{}^{m,i} = \alpha^i + \delta_0 \boldsymbol{h}_{t-1}{}^{m,i} + \delta^i{}_1 \boldsymbol{X}_t + \delta_2 \ln H(0)^i{}_t + \nu^i{}_t, \qquad \text{(A5)}$$

where $\boldsymbol{h}_t{}^{m,i} = \ln(H_t{}^{m,i} / Y_t)$.

Next, we estimate the current debt-to-GDP ratio using the following equation:

$$d_t = \alpha + \gamma_i d_{t-1} g_t^{-1} + \gamma_2 \boldsymbol{X}_t + e_t, \qquad \text{(A6)}$$

where $g_t = Y_t / Y_{t-1}$

Substituting the estimated values from equations (A5) and (A6), we calculate $\tilde{P}_t$, solving for the market clearing condition as follows:

$$\tilde{P}_t = \frac{\sum^{I}_{t=1} \exp\left(\widehat{\boldsymbol{h}_t^{m,l}}\right)}{\widehat{d_t}} \quad \text{(A7)}$$

The instrument for zero-coupon yield is then estimated using the following equation:

$$\tilde{P}_t = (1 + \tilde{y}_t)^{-T} \quad \text{(A8)}$$

Using the estimated $\tilde{y}_t$, we estimate the second equation of the two-stage least square regression as follows:

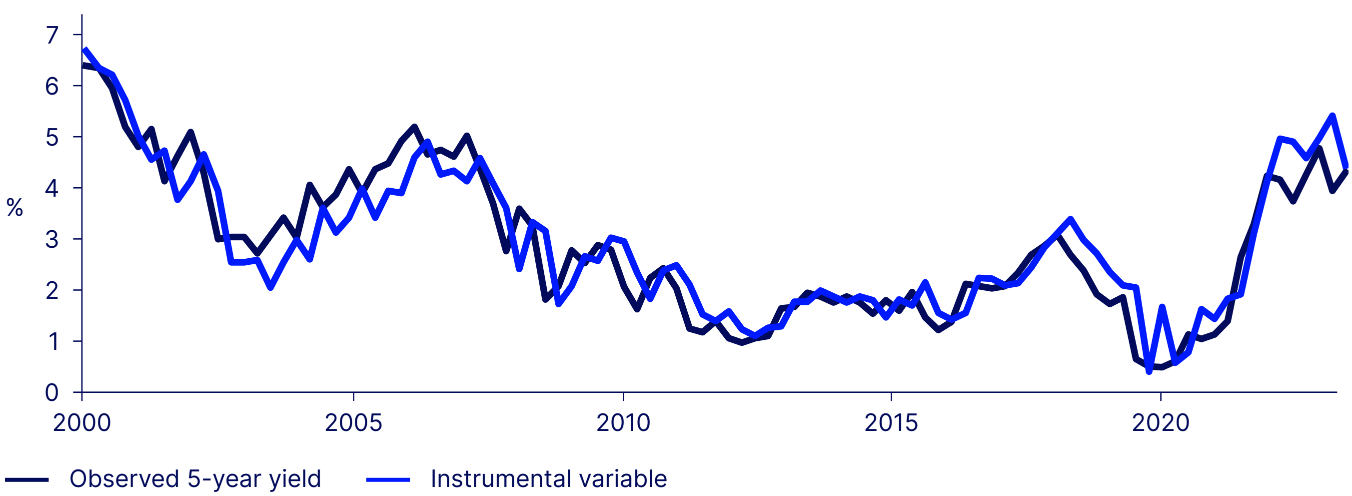
$$\ln(H^i_t) = \alpha^i + \beta^i_0 \ln\left(\frac{H^i_{t-1}}{H_D(0)^i_{t-1}}\right) + \beta^i_1 \tilde{y}_t + \beta^i_2 \boldsymbol{X}_t + \beta^i_3 \ln H_D(0)^i_t + \eta^i_t, \quad \text{(A9)}$$

where β^i_i gives a direct measure of yield semi-elasticity of demand, and ϵ^i_t is the residual term in the regression equation.

We continue to include macroeconomic variables $\boldsymbol{X}_t$ that were indirectly used to construct the instrumental variable $\tilde{y}_t$ in the above equation to account for the heterogeneous direct impact of macroeconomic variables on investor holdings that are not captured in the estimation of $\tilde{y}_t$.

Figure A1 plots the co-movement of the observed yield and the instrumental variable.

Figure A1: Observed yield vs. instrumental variable without latent demand



Source: Macrobond, Authors' estimates

Appendix B: Derivation of Counterfactual Analysis

The objective of counterfactual analysis is to estimate the aggregate yield impact from additional US Treasury supply to be absorbed by different investors. To make this calculation, we need to first measure what will happen to the yield if the government issues one more percent of debt. Mathematically, we need to calculate $dy_t \,/\, dln(D_t)$.

Following Fang, Hardy, and Lewis (2023), we start from the market clearing equation for the US Treasury, which is:

$$P_t D_t = \sum_{i=1}^{N} P_t^i H_t^i \quad \text{(B1)}$$

where P_t is the price of US Treasury and P_t^i is the price faced by investor group i. In equilibrium, $P_t = P_t^i$. As $P_t = \exp(-Ty_t)$, Equation (B1) can be rewritten as:

$$y_t = \frac{1}{T}\left(ln(D_t) - ln\sum_{i=1}^{N} P_t^i H_t^i\right) \quad \text{(B2)}$$

Differentiating with respect to $ln(D_t)$, we get:

$$\frac{dy_t}{dln(D_t)} = \frac{1}{T} - \frac{1}{T}\left(\frac{\sum_{i=1}^{N} \frac{d(P_t^i H_t^i)}{dH_t^i}\frac{dH_t^i}{dD_t} D_t}{\sum_{i=1}^{N} P_t^i H_t^i}\right) \quad \text{(B3)}$$

Based on the marginal response analysis, we know that investor i's marginal response is $\gamma_i = dH_t^i \,/\, dD_t$. From Equation (2), we have $\beta_1^i = dln(H_t^i) \,/\, dy_t$, which is the semi-elasticity of demand with respect to yield. With these, Equation (B3) can be rewritten as:

$$\frac{dy_t}{dln(D_t)} = \frac{1}{T} - \frac{1}{T}\left(1 - T\sum_{i=1}^{N}\frac{\gamma_i}{\beta_1^i}\right) = \sum_{i=1}^{N}\frac{\gamma_i}{\beta_1^i} \quad \text{(B4)}$$

State Street Corporation
One Congress Street, Boston, MA 02114-2016

www.statestreet.com

6900157.1.1.GBL
Expiration date: August 14, 2026