When do Treasuries Earn the Convenience Yield? — A Hedging Perspective

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Abstract

We document that the convenience yield of US Treasuries exhibits properties that are consistent with a hedging perspective of safe assets. The convenience yield tends to be low when the covariance of Treasury returns with the aggregate stock market returns is high. This effect is robust to controlling for the level of interest rates and the VIX, as well as controlling for the financial crisis. We decompose the aggregate stock-bond covariance and find that the negative relationship between convenience yields and stock-bond covariance is driven both by the covariance of the risk-free rate and stock returns, as well as of the covariance of convenience yields with stock returns, but quantitatively less so by the covariance of the US credit risk premium. Treasury covariance with the stock market reduces the safety premium also in other fixed-income money-like assets. We provide evidence that the convenience yield is adversely affected by heightened inflation expectations that erode the hedging properties of US Treasuries and other fixed-income money-like assets, and that induce a switch to alternatives such as gold. Finally, the relative convenience yield of US Treasuries over other safe government bonds increases with low values of the US stock-bond covariance.

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The U.S. Dollar plays a central role in the international monetary system as a reserve currency for settling financial payments and transactions underlying global trade. Relatedly, and likely consequently, dollar and safe dollar-based fixed-income assets, notably the U.S. Treasuries, command a so-called *exorbitant privilege* in their pricing due to an extraordinary demand from international community (central banks, for instance) looking for ways to park its dollar reserves. Increasingly, however, it is being recognized that the US safe assets–and safe assets, more generally–command such a premium in their pricing due not just to an international demand but also to a domestic demand.

Distilled to its essence, this "safe assets" perspective relies on the assumption that markets are effectively incomplete. Households, for example, face consumption shocks, inability to meet which would cause severe disutility. Corporations face liquidity shocks in their production or financing needs, failure to roll over which would lead to costly asset liquidations. Financial investors may face uninsurable background shocks as well due to exposure to illiquid assets such as housing and private equity. Banks prefer to make inter-bank loans collateralized by pristine quality assets rather than take on each others' counterparty credit risk as that may coincide with own funding shocks. While the arrival intensity and the impact of such shocks may be greater in less developed markets, they are considered to be of material significance even in highly developed or advanced market economies such as the United States.

Early contributions to the literature offering a safe-assets perspective often assumed by fiat that government bonds have safety and money-like properties and/or there is a built-in preference for such assets in investor or household objective functions: see Holmström and Tirole (2001), Krishnamurthy and Vissing-Jorgensen (2012). An important recent trend, however, is to micro-found these outcomes. It emerges from this latter approach that prices of assets whose financial values and/or liquidity covary inversely with aggregate risk should reflect an excess premium as such assets provide hedging value to economic agents when unspanned shocks materialize. The premium is magnified if assets provide a hedging benefit not just in a buy-to-hold sense but also from "service flow" or a retrading sense: agents value assets whose secondary market prices rise in times of aggregate risk, as in Brunnermeier et al. (2022), or whose liquidity rises in times of aggregate risk, as in Acharya and Pedersen (2005). The U.S. Treasuries are considered a primary candidate for being such assets, and the premium that accrues to their pricing is referred by the literature with a variety of terms such as "convenience yield", "money premium", or "bubble component."

In this paper, we document that this premium, which, for fixing terminology, we refer to as the *convenience yield* of U.S. Treasuries, exhibits properties consistent with the hedging perspective of safe assets. Our preferred measure of the Treasury convenience yield is the TIPS-Treasury premium: the yield differential between Treasury Inflation Protected Securities (TIPS) and maturity-matched nominal Treasuries, separately accounting for the inflation coupon payment of TIPS by employing traded inflation swap rates. This measure is based on the work by Fleckenstein et al. (2014) who demonstrate that in the 2004 to 2010 sample nominal Treasuries have almost always been more expensive than matched maturity TIPS, once the inflation coupon payment is accounted for. As described in detail below, we extend their measure of nominal Treasury convenience yields to 2022 and similarly find that TIPS are almost always underpriced relative to their nominal counterparts. (To the extent that TIPS themselves might carry a convenience yield, the TIPS-Treasury premium understates the convenience yield of Treasuries.)

To investigate the hedging properties of the US Treasuries as a driver of this convenience yield, we compute on a rolling, 30 trading day basis the covariance of 10 year zero coupon Treasury returns with the aggregate stock market returns, captured by the CRSP value-weighted market portfolio. We choose a short lookback window to capture the high-frequency aspects of the stock-bond covariance. The results in Laarits (2021) document a systematic component to the high-frequency variation: month-to-month variation in the stock-bond covariance corresponds to changes in credit spreads, and can predict relative returns of risky over safe bonds, as well as stock and FX returns.

We plot the aggregate stock-bond covariance in Figure 2. As is well documented in the literature, there was a gradual shift from positive to negative stock-bond covariance going from the mid-1970s all the way through the onset of the COVID pandemic. As has been documented extensively in the business press, the period in 2021 and 2022 saw a substantially positive stock-bond covariance as higher than expected inflation rates roiled the bond market (see Figure 1). A contention of the "service flow" or retrading view of Treasuries as safe assets is that this variation in the aggregate stock-bond covariance in part reflects the time variation in the convenience yield component of the Treasury prices.

Our principal result is that the convenience yield, as proxied by the TIPS-Treasury premium, tends to be low when the covariance of Treasury returns with the aggregate market returns is high. As we report in panel A of Table 2, a one standard deviation decrease in the stock-bond covariance (an increase in its hedging properties) corresponds to an increase of six basis points, or roughly a half standard deviation, in the convenience yield on the 10-year nominal Treasury. This result holds conditional on the risk-free rate, and is robust controlling for the level of the VIX or a dummy variable for the Financial Crisis. The result is also robust to lagging the covariance measure by a month, or using alternative measure of safe rates, such as the Liu and Wu (2021) nominal yield curve.

The TIPS-Treasury premium is only available from 2005 onwards due to the availability of inflation swap data. In order to extend the time period of our analysis to before 2005 (in some cases to 1972 to span the inflationary episodes that followed) as well as to examine whether the convenience yield of the US Treasuries is also mirrored in other safe fixed-income dollar assets, we turn to alternate measures of the convenience yield and to other money-like assets. Specifically, we use the General Collateral Repo rate spread over the 3-month T-bill rate (GC-Tr 3m), the effective Fed funds rate spread over the 3-month T-bill rate (FF-Tr 3m), the negative of the Z-spread, a measure that compares T-bill rates with yields implied by a fitted yield curve (-1*Z); the spread of P2-rated commercial paper over 3 month T-bills (P2-Tr.); and the AAA bond spread over long maturity Treasuries (AAA-Tr.)

The strength of the relationship between Treasury convenience yield proxies and the realized stock-bond covariance is quantitatively close to what we document for the TIPS-Treasury premium. In all cases, a one standard deviation decrease in the stock-bond covariance corresponds to about a third to two thirds of a standard deviation increase in the convenience yield proxy. The other proxies also allow us to start the sample period before 2005. For instance, in panels B and C of Table 2, we show that similar magnitude relationship between the convenience yield and stock-bond covariance obtains in the 1991-2022 sample as well as the 1972-2022 sample.

This relationship between the aggregate stock-bond covariance and the convenience yield appears to be driven both by the covariance of the risk-free rate as well as of the convenience yield itself. The TIPS-Treasury premium measure of the convenience yield allows us to separate out the effect of covariance into three components. In particular, the Treasury yield can be decomposed into three components: (i) the convenience yield, (ii) the "frictionless" risk-free rate, and (iii) the credit-risk premium proxied by the 10-year credit default swap (CDS) spread on the United States government as the reference entity. This decomposition, in turn, leads to three covariances with respect to the aggregate stock market. We plot the stock-bond covariance resulting from the premium part of the 10-year yield in the bottom panel of Figure 4. As the figure shows, the covariance yield contributes materially to the aggregate covariance, particularly in times of market stress: the Global Financial Crisis, the onset of the COVID pandemic, among others.

Re-estimating our baseline regressions with a decomposed stock-bond covariance, we find that the covariance attributable to convenience yield fluctuations is the most robust in explaining the convenience yield of safe US fixed-income assets, with the covariance attributable to the risk-free rate fluctuations playing a meaningful role too. In contrast, the covariance attributable to the CDS premium fluctuations contributes to the convenience yield only with a quantitatively small magnitude. Overall, this lends support to the theoretical models in Acharya and Pedersen (2005) and Brunnermeier et al. (2022).

Having established the key role played by the covariance of US Treasuries with the aggregate market return in explaining the Treasury convenience yield, it is important to ask what drives this covariance in the first place. As mentioned above, all the effects discussed above control for the level of interest rates, which have been shown by Nagel (2016) to be a first-order determinant of money premium (high interest rates raise the money premium of US fixed-income assets by making holding cash or dollar reserves more expensive). We show that the effects are also robust to controlling for the VIX, a "fear gauge" of the markets. And, while the effect of the covariance on the convenience yield is magnified during the global financial crisis of 2007-09 which triggered a run on the banking sector deposits and wholesale liabilities towards the US Treasuries, the effect is observed in normal times as well.

What then drives the covariance and (its effect on) the convenience yield? We show that inflation expectations are one important contributor. Note that the channel we have in mind is distinct from the that already established in the literature. Prior work, for instance Campbell et al. (2017) has highlighted the role of inflation dynamics, loosely, supply- or demand-driven shocks, in determining the stock-bond covariance. Our results highlight that in addition to the direct effect of inflation surprises on the risk-free rate, there is another channel that operates via the convenience yield.

We show that hedging properties of the US Treasuries as reflected in the covariance with respect to the aggregate stock return are eroded by heightened inflation expectations, the latter being measured either using the five-year inflation swap data or five-year inflation expectations of professional forecasters, consistent with the empirics in Li et al. (2022). This impact of inflation expectations can be seen saliently during the post-COVID-outbreak period of 2021-22 during which supply-side frictions and aggregate demand fueled by fiscal and monetary stimulus led to inflation prints rising significantly above the mandated Federal Reserve target and those witnessed over the past two decades, and in turn, resulted in a gradual upward shift in inflation expectations of households and investors.

Indeed, the relationship between the convenience yield and aggregate stock-bond covariance is also evident in the recent post-COVID-outbreak data. In the top panel of Figure 5 we show the time-series of different maturity TIPS-Treasury premia. As the panel shows, the onset of surprise inflation in 2021 coincided with a drop in the long maturity TIPS-Treasury premium. The bottom panel in turn demonstrates that such periods of lower convenience yields saw higher values of the aggregate stock-bond covariance. So, just like in the longer sample, we see burst of higher-than-expected inflation in 2021 and 2022 lead to an erosion in the Treasury convenience yield.

In the final section of the paper, we examine the substitutability between US Treasuries and alternate hedging instruments: precious metals and other hard currency fixed income securities. We carry out this analysis in the whole sample, as well as around specific events that erode the convenience yield of various securities.

With respect to precious metals—gold and silver—we follow Jermann (2021) in constructing measures of convenience yield from the respective futures contracts term structures. We find that the convenience yield of gold, though not silver, is strongly countercyclical relative to the convenience yield of Treasuries.

With respect to other hard-currency government bonds, we construct a measure of *relative* convenience yield of the US Treasuries relative to other safe-haven country bonds using the approach of Du et al. (2018). We first confirm that their measure of relative US Treasury convenience yield has a negative relationship with the stock-bond covariance, meaning, negative stock-bond covariance in the US tends to see larger US Treasury premium. We then repeat the analysis country-by-country. We find that the US Treasury premium over foreign currency bonds tends to increase with a negative stock-bond covariance, with the exception of German and UK bonds.

Finally, we provide three specific case studies to illustrate sharply the link between the hedging properties of US Treasuries and the Treasury convenience yield: the debt ceiling standoff, the Eurozone crisis, and the Gilt panic of late 2022. These case studies also, however, illustrate the challenges in understanding the relative convenience yields as they depend on hedging properties of safe assets for the representative investors in different economies (assuming some market segmentation) and also seem to be influenced by unconventional policy measures of central banks in response to advanced-economy sovereign credit risk episodes of the past decade.

Overall, we conclude that the hedging perspective for safe assets leads to an empirically useful framework for understanding the convenience yield built into the prices of US fixed-income assets.

Our results have several implications for theory and empirical work on safe assets as well as for policy. Observed time-series variation in the covariance of US Treasury returns with the aggregate stock market return, and its linkage to inflation expectations, implies that the moneyness or safe-asset properties of US Treasuries and fixed-income assets are not a given, these properties fluctuate over time, and importantly, are tied to macroeconomic developments in the economy. Conversely, as a portion of the safe-asset property of US Treasuries is related to a comovement of the convenience yield itself with aggregate risks, the "good friend" property (in the terminology of Brunnermeier et al. (2022)) can erode swiftly once high inflation outcomes materialize and the anchoring of inflation expectations becomes weaker. In some sense, there is a double whammy when this occurs, as safe assets lose value not only in terms of lower time value of their nominal cash flows but also due to erosion of convenience yield.

These linkages, therefore, underscore the importance of inflation-targeting framework and attainment of its goals by the Federal Reserve for keeping secure the safe-asset properties of US Treasuries and the demand for them, and in turn, for keeping contained the government borrowing costs. In other words, the convenience yield of government bonds must be "earned" by the government and their agencies such as the central bank by ensuring bonds retain their hedging properties for unspanned shocks faced by households, investors, financial firms, and corporations.

Last, but not the least, our findings present a complementary rationale for why the US Treasuries may become "inconvenient" to the one offered by He et al. (2022) and Haddad et al. (2021). These papers document that during the COVID outbreak of February and March 2020, US Treasuries – especially the long-term ones – did not seem to benefit from a flight to quality observed during the global financial crisis (GFC) of 2007-09, and if anything, they appeared to be experiencing fire sales until the Federal Reserve stepped in to provide liquidity to the market. Authors attribute this outcome to the unwinding of leveraged positions in cash-futures basis market, limited intermediation capacity of dealer banks due to post-GFC reforms, and rollover risk faced by non-bank financial intermediaries. In contrast to this episodic erosion of convenience yield of the US Treasuries, the erosion linked to a rise in covariance of US Treasury returns with aggregate stock returns – partly in response to higher inflation – is more slow-moving, was observed also in 1970s and 80s, and represents a present and clear loss of investor ability to hedge aggregate risks.

1 Measuring the Stock-Bond Covariance

We begin our analysis by documenting a high-frequency dynamics of the aggregate stock-bond covariance. We calculate the covariance between the daily CRSP value-weighted stock portfolio return and the daily 2-, 5-, and 10-year zero coupon constant maturity Treasury bond returns in a rolling 30 trading day window. We then average the daily calculated covariances to a monthly frequency. We carry out equivalent calculations using zero coupon real rates as well. Zero-coupon nominal and real bond prices are from the daily fitted yield curves constructed by Gürkaynak et al. (2007) and Gürkaynak et al. (2010), respectively.

The covariances are reported on an annualized basis in percent units. To give an example, if the daily stock return volatility is 2%, daily bond return volatility is .5% and the correlation between the two return series is -.6, the covariance would be reported as $-.6 \times .02 \times .005 \times 252 = -1.512\%$.

The summary statistics of the aggregate stock-bond covariance are reported in Table 1 panel A. In the 2005-2022 sample the 10-year nominal bond return covariance with the stock market is on average negative (-.59) and has the standard deviation of 1.1.

2 Measuring the Treasury Convenience Yield

2.1 TIPS-Treasury Premium

Our main proxy for the Treasury convenience yield is based on the relative pricing of nominal and real Treasury bonds. As shown in Fleckenstein et al. (2014), the prices of nominal Treasuries are consistently above the prices of matched maturity TIPS prices, accounting for the variable inflation coupon payment part via traded inflation swap rates. Because these two securities—a nominal bond, and a matched maturity TIPS with inflation coupon payment hedged away—have identical cash-flows we interpret this gap in prices as a proxy for the convenience yield. Our interpretation is consistent with the result in Fleckenstein et al. (2014)

Relative to the method in Fleckenstein et al. (2014) we use a simpler method of constructing a high-frequency TIPS-Treasury premium. Instead of comparing the prices of pairs of specific nominal and real Treasuries, we instead employ the fitted nominal and real yield curves from Gürkaynak et al. (2007) and Gürkaynak et al. (2010), respectively. We cal, and adjust it with the corresponding maturity

This method results in a day-maturity level proxy of the Treasury convenience yield that is not identical, but highly correlated with the measure documented in Fleckenstein et al. (2014) (the correlation between the two calculations is .91 in the 2004-2014 sample). Relative to that proxy, our construction has the advantage that the yield curve estimation smooths over some of the security-specific pricing factors that could add noise to the measure using pairs of securities, thus being potentially a better proxy for the Treasury-level convenience yield that we are interested in. Our measure is also much more straightforward to construct. Whenever necessary to distinguish this measure from the calculation in Fleckenstein et al. (2014) we use the term "Simple TIPS-Treasury premium."

Note that changes in realized or expected inflation should not have any directional impact on this measure of the convenience yield: the dependence of TIPS payouts on the inflation rate is hedged away using swaps. Indeed, Fleckenstein et al. (2014) provide evidence against the view that the TIPS-Treasury premium reflects mispricing in the inflation swap market by showing that real and nominal corporate bond prices do not exhibit corresponding price disparities.

That said, there is another source of potential bias on the TIPS-Treasury premium that stems from the contractual features of TIPS: these bonds pay a variable inflation coupon, but in the event of deflation the inflation coupon is bounded at zero. This means that TIPS prices incorporate a put premium if the distribution of the price level includes deflationary outcomes. For that reason, shift away of the probability mass from deflationary outcomes, such as we had in 2021 and 2022 would have the impact of reducing TIPS prices, hence increasing the proxy of convenience yields.

2.2 Direct Decomposition

The availability of the TIPS-Treasury premium at a high frequency allows us to carry out a decomposition of the aggregate stock-bond covariance. Namely, the maturity n yield at time t can be represented as the combination of a "frictionless" risk-free rate, the default rate on U.S. debt, as proxied by the CDS rate,[1] and the maturity n convenience yield.

$$\text{Yield}_{t,n} = \text{Risk-free}_{t,n} + \text{CDS}_{t,n} - \text{Premium}_{t,n} \tag{1}$$

For instance, having decomposed the 10-year yield according to Equation (1), we calculate the stock-bond covariance with returns implied by each of these constituent parts of the yield. To

[1] See Chernov et al. (2020) for a quantitative analysis of the U.S. CDS rates.

maintain easy comparability with the benchmark calculation, we transform each of these yield parts into "returns" by multiplying with -10. Note that by construction, the sum of these three covariances has to equal the covariance calculated with the 10-year nominal Treasury yield.

The time series of the stock-bond covariance calculated with the 10-year TIPS-Treasury premium is plotted in the bottom panel of Figure 4. The summary statistics regarding all three covariances are reported in panel B of Table 1.

Let us now turn to other proxies of the convenience yield.

2.3 GC Repo - Treasury Bill spread

Our second proxy for the convenience yield is the spread between three month General Collateral (GC) Repo contract rates and the three-month Treasury Bill rate. This measure has been widely used in the literature as a proxy for the short-term convenience yield as the GC repo contract is devoid of credit risk but less liquid than Treasury bills.

2.4 Fed Funds - Treasury Bill spread

The third proxy for the convenience yield is the spread between the effective Fed funds rate and the three month Treasury Bill rate.

2.5 Z-spread

Our fourth proxy is the negative of the Z-spread, constructed after Greenwood et al. (2015). They measure the yield difference of n month maturity Treasury Bills from the fitted yield curve of Gürkaynak et al. (2007) and call the gap the n-month Z-spread. We replicate their calculation by calculating the average Z-spread of T-bills with 4 to 26 weeks until maturity. In contrast to these authors we report the negative of the difference between the T-bill rate and the fitted yield curve, so that higher values of the Z-spread correspond to higher levels of convenience. We emphasize this distinction by calling it "-1*Z-spread" or "-1*Z" for short.

2.6 P2 Commercial Paper - Treasury Bill Spread

90 day maturity, data from Krishnamurthy and Li (forthcoming). In contrast to the GC Repo T-bill spread this measure captures some amount of credit risk.

2.7 AAA-Treasury spread

The final proxy for the convenience spread of Treasuries is the AAA-Treasury yield spread using daily data from Moody's. Krishnamurthy and Vissing-Jorgensen (2012) demonstrate that the AAA-Tr. spread has a strong negative correlation with the aggregate supply of Treasuries, consistent with the convenience of Treasuries being a important driver of their yields. Like the P2 CP spread, this measure again captures some amount of credit risk.

2.8 U.S. Treasury Premium

In the international context we proxy for the relative convenience yields of the U.S. Treasuries with respect to other government bonds using the U.S. Treasury Premium measure from Du, Im and Schreger (2018).

3 Convenience Yield and the Stock-Bond Covariance

Our baseline results document a strong association between the level of the Treasury convenience yield and the aggregate stock-bond covariance. In panel A of Table 2 we report monthly regressions of six measures of the convenience yield on the monthly stock-bond covariance using the 10-year zero coupon nominal Treasury return, controlling for the effective Fed funds rate.

The estimated effect size is large: a one standard deviation decrease in the aggregate stock-bond covariance (about 1.1) corresponds to a half standard deviation increase of the 10-year TIPS-Treasury premium. Similar magnitudes obtain for the other five proxies of the Treasury convenience yield. Note that in all of the regressions we control for the contemporaneous level of the Fed funds rate. This choice is motivated by the finding in Nagel (2016) that the level of convenience yields tends to have a strong association with the level of the risk-free interest rate.

Panels B and C of Table 2 repeat the same analysis but extend the sample back to 1991 and to 1972, respectively. Because of the availability of TIPS and inflation swap data we lose the TIPS-Treasury measure in panel B; because of the availability of General Collateral Repo rates we lose the three month GC Repo-Treasury measure in panel C.

The results from these longer samples are consistent with the findings in panel A. In all cases, we find a negative relationship between the proxies of the convenience yield and the stock-bond covariance. With once exception, all the coefficients in these longer samples are statistically significant at the 10%, with two exceptions these coefficients are statistically significant at the 5% level.

In Table 4 we carry out two robustness exercises for the main results in Table 2. In panel A we include a dummy variable for the the financial crisis years 2008-09 as well as an interaction term of the aggregate stock-bond covariance with the crisis dummy. While the covariance interaction term with the crisis dummy absorbs some of the effect, the benchmark coefficient remains negative and statistically significant at the 5% for the TIPS-Treasury convenience yield measure, suggesting that the results are not driven by the crisis period alone. In panel B we include VIX as a right-hand-side variable. Again, the main coefficients of interest on the aggregate stock-bond covariance remain largely unchanged, indicating that we are not picking up just an aggregate volatility effect.

As discussed in Section 2.2 above, the TIPS-Treasury premium provides a useful decomposition of the nominal Treasury yield into three components: the "frictionless" risk-free rate, the default spread, and the Treasury specialness. And such decomposition of yields into constituent parts makes it possible to decompose the stock-bond covariance.

We carry out this decomposition and plot the aggregate stock-bond covariance using the Treasury premium component only in the bottom panel of Figure 4. In Table 3 we re-estimate the benchmark results with the stock-bond covariance implied by each of these three constituent parts of the ten year yield. By construction, the sum of these three covariance parts exactly equals the aggregate stock-bond covariance used previously.

The regression analysis in Table 3 shows that all three constituent parts have a negative relationship with the proxies of the convenience yield. Consistently across proxies for the convenience yield, we document that the coefficient corresponding to Cov(Prem. 10y, St.)—the covariance from the TIPS-Treasury premium with the stock market—is negative and statistically significant, in line with the argument that the hedging properties of the convenience yield contribute to its level. The covariance term corresponding to the "frictionless" risk-free rate tend to have negative coefficients as well. Finally, the term corresponding to CDS innovations also though this covariance is much smaller in magnitude, as shown in panel B of Table 1.

3.1 Inflation Expectations

Existing literature has extensively studied the the impact of expected inflation shocks on the stock-bond covariance (for instance, see Campbell et al. (2017). Our focus on the convenience yield part of Treasury yield suggests an additional channel by which inflation expectations contribute to the stock-bond covariance.

To that end, we document that increased inflation expectations tend to erode the convenience yield. We use two proxies for expected inflation: the five year inflation swap rate, and the Cleveland Fed five year expected inflation series that combines both survey and market data. In Table 5 panel A we confirm that these two proxies of inflation expectations have a positive relationship with the stock-bond covariance.

In panel B of Table 5 we study the impact of inflation expectations on the six proxies of the convenience yield. With the exception of the 3 month Fed Funds Treasury bill spread, all convenience yield proxies demonstrate a negative relationship with expected inflation, controlling for the stock-bond covariance. The size of the effect is considerable: a one standard deviation increase in expected inflation corresponds to a drop of a third of standard deviation in the TIPS-Treasury convenience yield measure. In panel C we extend the sample back to 1982. We lose the TIPS-Treasury and GC Repo-Treasury spreads, but the Fed funds-Treasury bill and Z-spread proxies again have a negative relationship with expected inflation.

We re-estimate all these these regressions in the recent data in Table 6. Here we are focusing on the three years since 2020, thus focusing on a period with substantial inflation dynamics: first a drop in inflation at the onset of the COVID pandemic, and then persistent higher-than-expected inflation in 2021 and 2022. Overall, we see a similar negative relationship between inflation expectations and the convenience yield as in the longer sample, suggesting a novel channel via which inflation expectations affect the stock-bond covariance. Namely, heightened inflation expectations erode the convenience yield which in turns reduces the hedging properties of long bonds.

3.2 Other Convenience Yields

The time variation in Treasury convenience yield suggests that other investments serving such a role could similarly time variation in their convenience yields as well. We study two such asset classes: precious metals and other government bonds.

We follow Jermann (2021) and calculate the convenience yield of gold and silver futures contracts. In Table 7 we regress the gold and silver convenience yields on the contemporaneous TIPS-Treasury premium, and the stock-bond covariance. We find that an increase in the TIPS-Treasury premium tends to reduce the gold convenience yield, though we don't find a corresponding statistically significant effect on the convenience yield of silver, suggesting a special role for gold in times of lower Treasury convenience.

In panel A of Table 8 we study the relative convenience yields of other government bonds with respect to the US Treasury. We follow Du et al. (2018) to estimate the relative convenience yield of each pair of bonds. In the aggregate, we find that negative stock-bond covariance in the US tends to see the relative convenience of the US Treasury. Looking bond-by-bond, though, the results are mixed: with the exception of the Gilt, all relative convenience yields tend to open up in times of negative stock-bond covariance, though this effect is not always statistically significant. In panel B we show that similar results obtain when controlling for the stock-bond covariance of the foreign bond with the US equity market returns.

4 Convenience Yield Event Studies

Finally, we revisit a number of events from recent history that have seen large increases or drops in the US Treasury convenience yield.

First, we consider the US debt ceiling "crisis"of August 1, 2011. As shown in Figure 6, leading up to the crisis date, the covariance of US Treasuries and aggregate stock return rose and the convenience yield of US Treasuries *both* declined. These patterns reversed sharply soon after a default was averted. While there was a rise in the US CDS premium in build-up to the crisis date, especially at the short maturity of one year,[2] its covariance with aggregate stock returns is quantitatively too small to explain the fall in convenience yield.

Interestingly, the pattern of convenience yield holds both for the TIPS-Treasury premium, which can be considered an absolute measure of the Treasury convenience yield, as well as for the Du et al. (2018) measure of the US Treasury premium relative to the German Bunds. This suggests that there was a reduction in the hedging quality of US Treasuries immediately prior to the debt-ceiling crisis, both in an absolute and a relative-to-other-safe-assets sense.

Next, we examine the convenience yield of the US Treasuries relative to the German Bunds during the Eurozone sovereign debt crisis period of 2010-2012. In Figure 7 we plot the TIPS-Treasury premium, and the relative convenience yield of the US Treasury relative to Germany government bonds. These two case studies help further clarify that understanding the relative convenience yield of US is rather nuanced as it requires a joint or a comparative understanding of the hedging properties of the respective government bonds. In particular, vulnerability of the Eurozone (periphery countries, specifically) causes the absolute convenience yield of the US Treasuries to rise but that relative to the German Bunds to fall due to a flight-to-safety premium in the latter; stabilization measures by the European Central Bank restore the relative convenience yield of the US Treasuries as they dampen the flight-to-safety to German Bunds.

5 Related Literature

6 Conclusion

We argue that the hedging perspective for save assets is a quantitatively important channel to capture the Treasury convenience yield: we document that times when the aggregate stock-bond covariance is large and negative see a widening of Treasury convenience yields. In a decomposition of the aggregate stock-bond covariance into terms corresponding to a frictionless risk-free rate, the

[2]See Chernov et al. (2020) on the U.S. CDS rate.

CDS rate, and a convenience yield, we find that the convenience yield component contributes to the aggregate hedging properties of the Treasury, particularly during times of market stress.

We additionally show that heightened inflation expectations erode the convenience yield, and by extension, thus reduce the hedging properties of Treasuries. Our results imply that that the safe asset properties of US Treasuries are not to be taken as given, but need to be “earned”. The results also underline the connection between Treasury market functioning and the low cost of borrowing for the government.

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7 Tables

Panel A.

	mean	p1	p10	p50	p90	p99	sd	count
Cov(Tr 10y, St.)	-0.59	-5.10	-1.41	-0.31	0.15	1.73	1.11	216
Cov(Tr 5y, St.)	-0.27	-2.97	-0.71	-0.14	0.06	0.79	0.56	216
Cov(Tr 2y, St.)	-0.08	-0.89	-0.22	-0.03	0.02	0.38	0.22	216
Cov(Prem. 10y, St.)	-0.34	-5.23	-0.77	-0.14	0.07	0.59	0.96	216
Cov(Rf 10y, St.)	-0.28	-3.10	-0.97	-0.17	0.25	1.81	0.83	216
Cov(CDS 10y, St.)	0.03	-0.34	-0.06	0.00	0.18	0.73	0.16	216

Panel B.

	mean	p1	p10	p50	p90	p99	sd	count
10y TIPS-Tr	0.29	0.02	0.17	0.28	0.37	1.04	0.14	216
5y TIPS-Tr	0.28	0.02	0.10	0.24	0.47	1.05	0.20	216
2y TIPS-Tr	0.26	-0.13	0.02	0.25	0.44	1.45	0.26	216
GC-Tr 3m	0.14	-0.03	0.03	0.10	0.29	0.63	0.13	216
FF-Tr 3m	0.09	-0.64	-0.08	0.05	0.30	1.22	0.27	216
-1*Z-spr.	0.14	-0.07	0.01	0.12	0.23	0.59	0.13	216
P2-Tr.	0.59	0.13	0.23	0.42	1.23	5.21	0.72	216
AAA-Tr.	1.00	0.49	0.60	0.99	1.38	1.83	0.29	216
Eff. Fed Funds	1.31	0.05	0.07	0.22	4.52	5.33	1.69	216

Panel C.

	mean	p1	p10	p50	p90	p99	sd	count
5-year E[Inflation]	1.82	1.01	1.34	1.74	2.46	2.68	0.41	216
5-year Inf. Swap Rate	2.18	0.56	1.59	2.18	2.91	3.27	0.55	216
US Premium	-15.24	-53.03	-32.47	-15.52	5.59	14.30	14.84	216
6m. GC Conv.	-2.36	-6.17	-5.25	-1.84	-0.55	-0.09	1.69	216
6m. SI Conv.	-2.87	-7.20	-5.28	-2.37	-0.81	0.88	1.95	216

Table 1: Summary Statistics. Monthly data 2005-2022. Panel A: the stock-bond covariance calculated using 10-, 5-, 2-year and 3- month constant maturity Treasury returns and the CRSP value-weighted stock market return in a 30 trading day lookback window, averaged to monthly variable. Panel B: 10-, 5-, and 2-year TIPS-Treasury premium, 3 month GC repo and Fed Funds rate spread to Treasury bills, negative of the Z-spread, P2-rated commercial paper spread, effective Fed funds rate. Panel C: Cleveland Fed five year expected inflation, Five year inflation swap rate, US Treasury convenience yield relative to other government bonds, six month convenience yield on gold (GC) and silver (SI) futures contracts.

Panel A.

	2005-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.06**	-0.05***	-0.09**	-0.04	-0.49***	-0.11***
	(-2.23)	(-2.81)	(-2.06)	(-1.47)	(-3.09)	(-4.78)
Eff. Fed Funds	0.01**	0.03**	0.05*	0.01	0.11***	-0.09***
	(2.08)	(2.56)	(1.93)	(0.86)	(3.52)	(-6.29)
Constant	0.23***	0.07***	-0.05	0.10***	0.16**	1.05***
	(11.51)	(3.40)	(-1.32)	(5.44)	(2.19)	(21.06)
Observations	216	216	216	216	216	216
R^2	0.225	0.231	0.192	0.114	0.552	0.546

Panel B.

	1991-2022				
	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.05***	-0.10***	-0.04*	-0.39***	-0.15***
	(-2.96)	(-2.80)	(-1.65)	(-2.78)	(-6.51)
Eff. Fed Funds	0.03***	0.06***	-0.02***	0.11***	-0.03*
	(5.38)	(5.63)	(-3.92)	(6.50)	(-1.67)
Constant	0.05**	-0.07**	0.11***	0.19***	0.95***
	(2.50)	(-2.33)	(6.10)	(3.28)	(17.48)
Observations	380	384	384	380	384
R^2	0.222	0.269	0.245	0.438	0.356

Panel C.

	1972-2022			
	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.11***	-0.01	-0.30**	-0.13***
	(-2.86)	(-0.57)	(-2.17)	(-5.95)
Eff. Fed Funds	0.14***	-0.04***	0.14***	0.02**
	(10.10)	(-7.23)	(7.95)	(2.41)
Constant	-0.25***	0.18***	0.17***	0.89***
	(-4.41)	(7.86)	(2.90)	(19.05)
Observations	612	612	584	612
R^2	0.591	0.388	0.415	0.095

Table 2: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. Left hand side variables are proxies of the convenience yield. The selection of left hand side variables in each panel reflects their availability in the indicated time period. Right hand side variables are the monthly stock-bond covariance and the effective Fed Funds rate. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

	2005-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Prem. 10y, St.)	-0.08**	-0.05**	-0.07**	-0.06*	-0.58***	-0.13***
	(-2.13)	(-2.48)	(-2.10)	(-1.69)	(-2.99)	(-4.80)
Cov(Rf 10y, St.)	-0.04	-0.05***	-0.13*	-0.01	-0.41***	-0.10***
	(-1.51)	(-2.91)	(-1.93)	(-0.42)	(-3.10)	(-5.47)
Cov(CDS 10y, St.)	-0.15	-0.18***	-0.29*	-0.12	-1.22***	-0.42***
	(-1.32)	(-3.14)	(-1.95)	(-1.47)	(-3.49)	(-3.00)
Eff. Fed Funds	0.01**	0.03**	0.05*	0.01	0.11***	-0.09***
	(2.10)	(2.54)	(1.92)	(0.92)	(3.39)	(-6.36)
Constant	0.23***	0.08***	-0.04	0.11***	0.18**	1.06***
	(10.85)	(3.66)	(-1.26)	(5.37)	(2.35)	(20.97)
Observations	216	216	216	216	216	216
R^2	0.268	0.255	0.225	0.205	0.607	0.580

Table 3: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. Left hand side variables are proxies of the convenience yield. 10-year Treasury yield split into the convenience yield, the risk-free yield and the CDS yield. Right hand side variables are the rolling stock-bond covariances estimated using these two constituent yields and the effective Fed Funds rate. Monthly data 2005-2022. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A.

	2005-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.02**	-0.03*	-0.09*	0.00	-0.21***	-0.07***
	(-1.98)	(-1.69)	(-1.70)	(0.30)	(-3.76)	(-3.84)
Crisis	0.02	0.02	0.26*	-0.11	-0.26	0.00
	(0.24)	(0.34)	(1.75)	(-1.41)	(-1.50)	(0.04)
Crisis x Cov	-0.09***	-0.03	0.08	-0.12***	-0.66***	-0.07**
	(-6.10)	(-1.10)	(1.23)	(-4.05)	(-7.21)	(-2.24)
Eff. Fed Funds	0.01	0.03**	0.05**	0.00	0.08***	-0.09***
	(1.31)	(2.36)	(2.01)	(0.32)	(2.76)	(-6.52)
Constant	0.24***	0.07***	-0.07	0.12***	0.26***	1.06***
	(12.16)	(3.28)	(-1.48)	(7.61)	(6.11)	(20.59)
Observations	216	216	216	216	216	216
R^2	0.400	0.255	0.242	0.323	0.804	0.569

Panel B.

	2005-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.04*	-0.05***	-0.11**	-0.01	-0.39***	-0.11***
	(-1.95)	(-2.89)	(-2.04)	(-0.68)	(-3.39)	(-4.49)
Eff. Fed Funds	0.02**	0.03**	0.05*	0.01	0.12***	-0.09***
	(2.45)	(2.51)	(1.74)	(1.17)	(3.88)	(-6.19)
VIX	0.52	-0.02	-0.59	0.54*	2.10**	0.03
	(1.54)	(-0.09)	(-1.17)	(1.71)	(2.01)	(0.06)
Constant	0.14**	0.07*	0.05	0.01	-0.21	1.05***
	(2.27)	(1.79)	(0.71)	(0.13)	(-0.90)	(11.65)
Observations	216	216	216	216	216	216
R^2	0.284	0.231	0.216	0.195	0.590	0.546

Table 4: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. In Panel A, the left hand side variables are various proxies of the convenience yield. The right hand side variables are the stock-bond covariance, an indicator variable for 2008-09, an interaction term of the indicator variable with stock-bond covariance, and the effective Fed Funds rate. In Panel B, the left hand side variables are as in Panel A, and the right hand side variables are the stock-bond covariance, effective Fed Funds rate and the VIX. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A. LHS: Cov(Tr 10y, St.)

	1982-2022	2005-22		2020-22	
5-year E[Inflation]	0.47***	1.04*		1.61	
	(3.56)	(2.00)		(1.38)	
5-year Inf. Swap Rate			1.11**		1.19*
			(3.07)		(2.36)
Eff. Fed Funds	0.01	-0.04	0.00	0.13	0.49***
	(0.35)	(-0.38)	(0.05)	(0.50)	(4.24)
Constant	-1.47***	-2.43**	-3.01***	-3.10	-3.56**
	(-5.32)	(-2.71)	(-3.78)	(-1.58)	(-2.65)
Observations	492	216	216	36	36
R^2	0.328	0.115	0.302	0.317	0.492

Panel B.

	2005-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.03	-0.03*	-0.09*	-0.03	-0.44***	-0.04**
	(-1.63)	(-1.72)	(-1.85)	(-1.21)	(-3.16)	(-2.10)
5-year Inf. Swap Rate	-0.15***	-0.05*	0.03	-0.05	-0.21	-0.27***
	(-3.97)	(-1.67)	(0.37)	(-1.55)	(-1.35)	(-5.25)
Eff. Fed Funds	0.03***	0.04***	0.05**	0.01	0.13***	-0.06***
	(4.41)	(3.47)	(2.10)	(1.29)	(3.40)	(-4.94)
Constant	0.55***	0.18**	-0.11	0.21***	0.61**	1.64***
	(6.69)	(2.29)	(-0.62)	(3.00)	(1.97)	(13.13)
Observations	216	216	216	216	216	216
R^2	0.416	0.258	0.195	0.140	0.567	0.704

Panel C.

	1982-2022			
	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.04	-0.01	-0.30**	-0.12***
	(-1.44)	(-0.37)	(-2.03)	(-5.36)
5-year E[Inflation]	-0.10*	-0.09***	0.20	-0.00
	(-1.78)	(-3.62)	(1.60)	(-0.03)
Eff. Fed Funds	0.13***	-0.00	0.05**	0.00
	(7.54)	(-0.54)	(2.11)	(0.05)
Constant	0.06	0.30***	-0.07	0.89***
	(0.61)	(6.54)	(-0.30)	(7.32)
Observations	492	492	488	492
R^2	0.595	0.554	0.341	0.160

Table 5: Expected Inflation and Proxies of the Treasury Convenience Yield. In Panel A the left hand side variable is the stock-bond covariance. The right hand side variables are five year expected inflation, five year inflation swap rate, and the effective Fed Funds rate. In Panels B and C the left hand side variables are proxies of the convenience yield. The right hand side variables in Panels B and C are five year inflation swap and the five year inflation expectations, respectively. Regression samples indicated in column headers. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A.

	2020-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.03***	-0.02***	-0.02	-0.01*	-0.27***	-0.12***
	(-3.81)	(-2.94)	(-1.40)	(-1.72)	(-16.45)	(-6.97)
Eff. Fed Funds	0.07***	0.02***	-0.14***	0.10***	0.18***	0.01
	(3.85)	(3.37)	(-4.76)	(8.91)	(8.38)	(0.21)
Constant	0.14***	0.02**	-0.03	0.06***	0.16***	0.83***
	(3.37)	(2.04)	(-0.60)	(4.53)	(5.93)	(12.20)
Observations	36	36	36	36	36	36
R^2	0.449	0.181	0.569	0.728	0.808	0.574

Panel B.

	2020-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.01	-0.02**	0.02	-0.00	-0.27***	-0.06***
	(-0.52)	(-2.00)	(1.54)	(-0.69)	(-12.72)	(-2.61)
5-year Inf. Swap Rate	-0.09***	-0.01	-0.12**	-0.01	-0.01	-0.18***
	(-3.51)	(-0.27)	(-2.43)	(-0.43)	(-0.26)	(-2.84)
Eff. Fed Funds	0.06***	0.02***	-0.15***	0.10***	0.18***	-0.01
	(4.19)	(3.42)	(-5.39)	(9.57)	(8.39)	(-0.45)
Constant	0.37***	0.04	0.29**	0.08*	0.20	1.28***
	(4.57)	(0.76)	(2.24)	(1.75)	(1.38)	(8.07)
Observations	36	36	36	36	36	36
R^2	0.679	0.183	0.657	0.729	0.809	0.755

Panel C.

	2005-22		2020-22	
	10y TIPS-Tr	10y TIPS-Tr	10y TIPS-Tr	10y TIPS-Tr
Cov(Tr 10y, St.)	-0.06**	-0.03	-0.02*	-0.01
	(-2.24)	(-1.63)	(-1.76)	(-0.52)
5-year E[Inflation]	-0.02		-0.14***	
	(-0.39)		(-2.70)	
5-year Inf. Swap Rate		-0.15***		-0.09***
		(-3.97)		(-3.51)
Eff. Fed Funds	0.02	0.03***	0.10***	0.06***
	(1.49)	(4.41)	(8.74)	(4.19)
Constant	0.26***	0.55***	0.35***	0.37***
	(3.68)	(6.69)	(3.45)	(4.57)
Observations	216	216	36	36
R^2	0.226	0.416	0.606	0.679

Table 6: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. In Panels A and B the left hand side variables are proxies of the convenience yield. Right hand side variables are the monthly stock-bond covariance and the effective Fed Funds rate. In Panel B the right hand side variables also include the five year inflation swap rate. Panel C the left hand side variable is the TIPS-Treasury premium and the right hand side variables include the five year inflation swap rate, the five year inflation expectations, and the effective Fed Funds rate. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A.

	6m Gold Conv.			6m Silver Conv.		
Cov(Tr 10y, St.)		0.05			-0.15	
		(0.93)			(-1.01)	
10y TIPS-Tr			-0.54***			0.70
			(-2.69)			(0.65)
Eff. Fed Funds	-0.92***	-0.93***	-0.92***	-0.46**	-0.44*	-0.47**
	(-20.77)	(-19.70)	(-20.85)	(-2.00)	(-1.87)	(-2.02)
Constant	-1.15***	-1.11***	-1.00***	-2.26***	-2.39***	-2.46***
	(-8.70)	(-7.42)	(-6.94)	(-7.39)	(-7.84)	(-5.28)
Observations	216	216	216	216	216	216
R^2	0.856	0.857	0.858	0.161	0.168	0.164

Table 7: Gold and Silver Convenience Yields and the Treasury Convenience Yield. Left hand side variables are the 6-month convenience yield in Gold and Silver futures contracts. Right hand side variables are the effective Fed Funds rate, stock-bond covariance, and the 10-year TIPS-Treasury premium. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A.

	2008-2022					
	US Prem.	-EUR prem.	-GBP prem.	-CHF prem.	-CAD prem.	-JPY prem.
Cov(Tr 10y, St.)	-3.36***	-1.57	3.03*	-0.58	-10.41**	-2.60
	(-2.87)	(-0.70)	(1.67)	(-0.43)	(-2.52)	(-1.04)
Eff. Fed Funds	-5.79***	-7.63*	-11.09***	-11.09***	0.68	-4.65
	(-3.23)	(-1.66)	(-3.91)	(-3.73)	(0.22)	(-1.57)
Constant	-17.23***	-13.99***	3.66	24.15***	-32.12***	41.52***
	(-7.66)	(-3.97)	(1.04)	(6.17)	(-7.49)	(7.83)
Observations	180	180	159	162	180	148
R^2	0.309	0.166	0.345	0.231	0.246	0.044

Panel B.

	2008-2022					
	US Prem.	-EUR prem.	-GBP prem.	-CHF prem.	-CAD prem.	-JPY prem.
Cov(Tr 10y, St.)	-3.36***	0.44	3.03	-1.80	-35.54***	-5.71***
	(-2.87)	(0.27)	(1.30)	(-0.98)	(-4.44)	(-3.26)
Eff. Fed Funds	-5.79***	-3.20	-14.99***	-11.60***	0.36	-5.11*
	(-3.23)	(-0.76)	(-6.25)	(-3.95)	(0.11)	(-1.65)
Cov Germany		1.73				
		(0.46)				
Cov UK			-1.73			
			(-0.40)			
Cov Switzerland				4.29*		
				(1.86)		
Cov Canada					35.59***	
					(2.91)	
Cov Japan						58.39**
						(1.99)
Constant	-17.23***	-10.95***	5.06	25.08***	-32.02***	41.40***
	(-7.66)	(-4.34)	(1.34)	(6.51)	(-7.03)	(7.42)
Observations	180	163	142	157	163	143
R^2	0.309	0.052	0.469	0.267	0.304	0.084

Table 8: Stock-Bond Covariance and Proxies of U.S. Treasury Premium. The left hand side variables are a proxy of relative US Treasury convenience yield over a basket of foreign currency denominated bonds, and proxies for the relative US Treasury convenience yield over the indicated foreign currency bond. The right hand side variables include the stock-bond covariance and the effective Fed Funds rate. Right hand side variables also include the stock-bond covariance calculated using the US equity market returns, and the indicated foreign bond returns. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

8 Figures

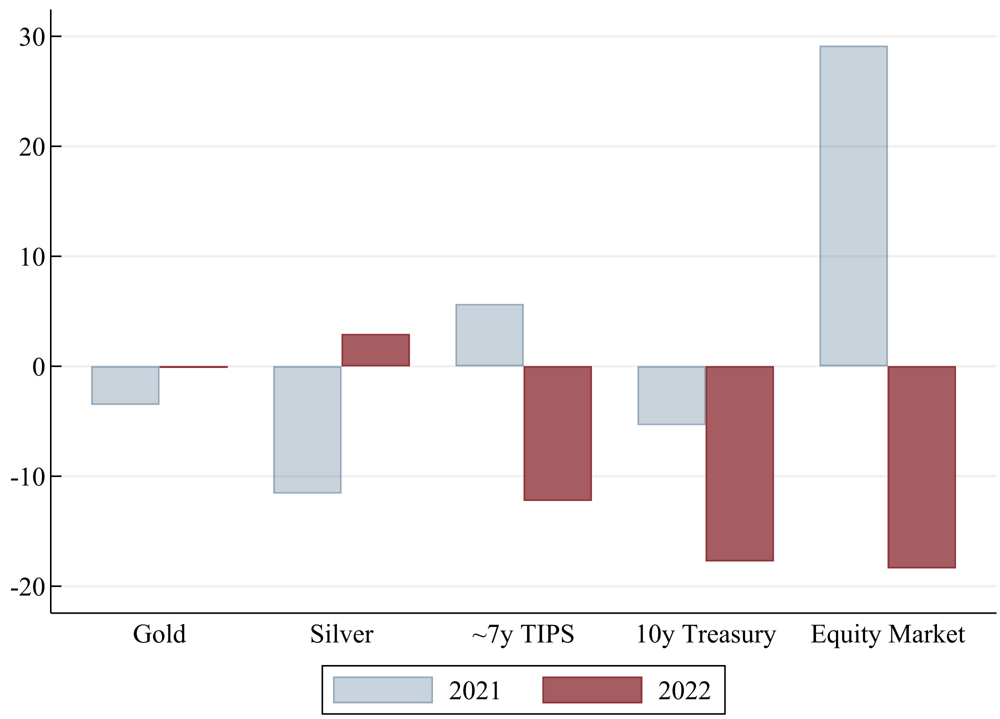


Figure 1: Returns in 2021 and 2022. Return on TIPS proxied by the return on TIP, a TIPS ETF with duration of approximately 7 years.

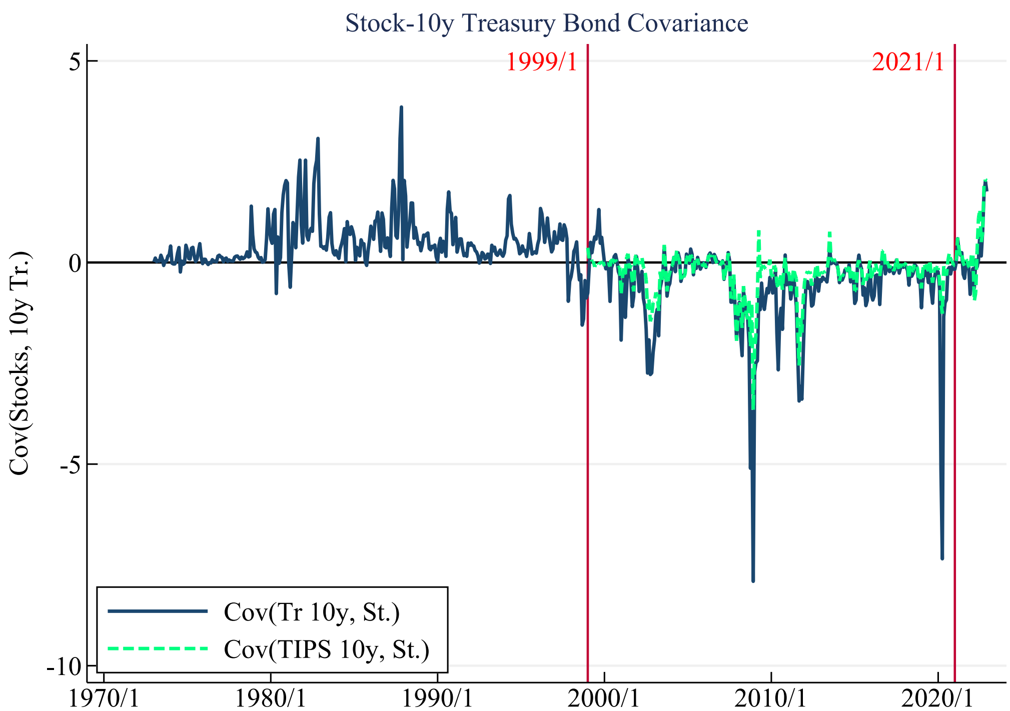


Figure 2: Stock-Bond Covariance. Nominal and real 10-year constant maturity bonds. Covariances with the market calculated from daily using a 30 trading day rolling window. Plots show monthly averages. Monthly data 1973-2022.

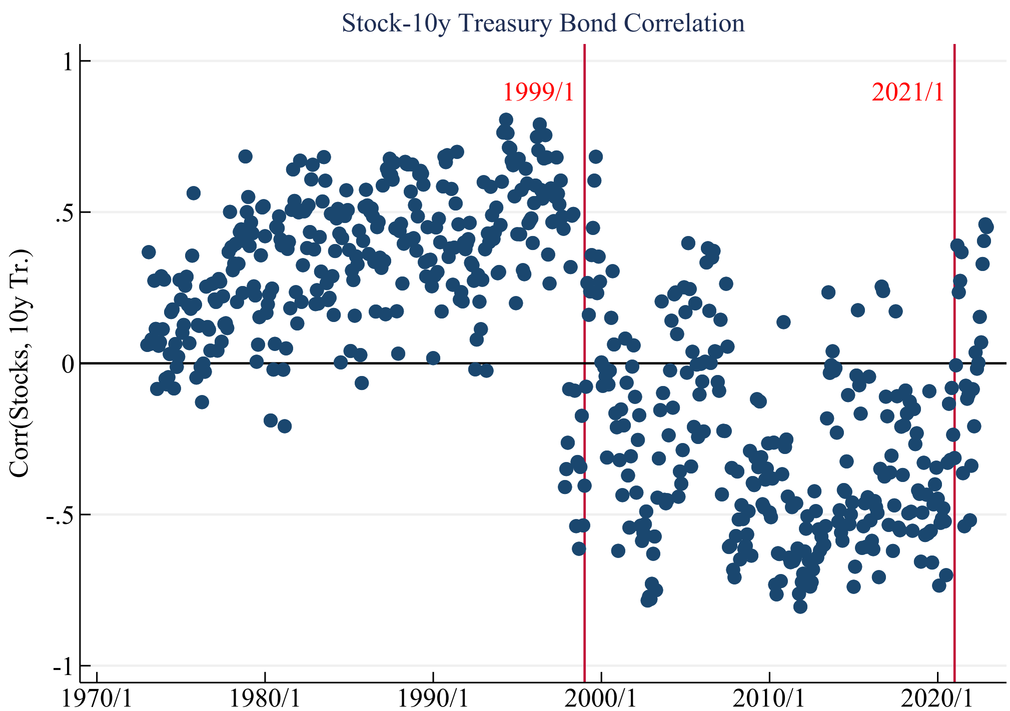
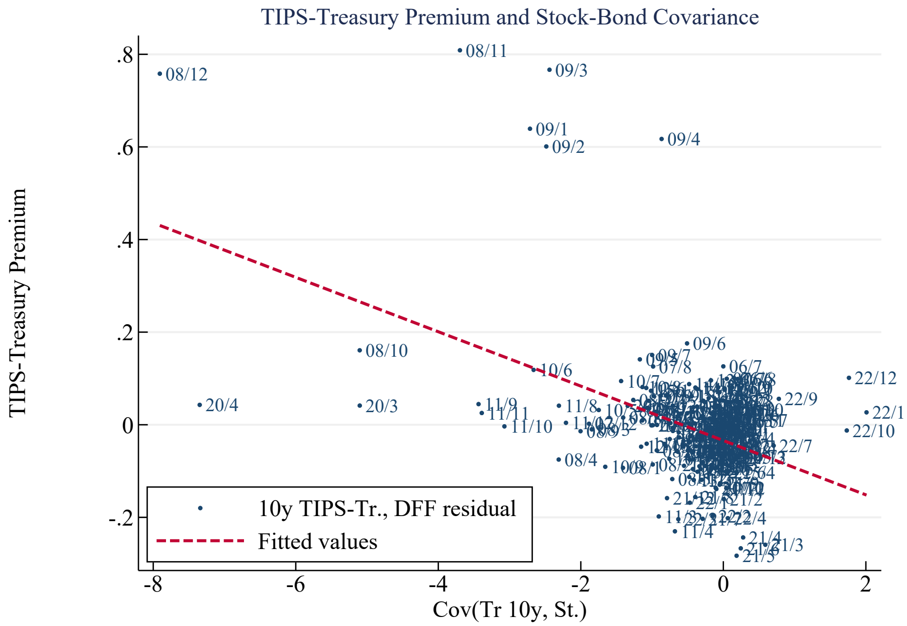


Figure 3: Stock-Bond Correlation. Nominal 10-year constant maturity bonds. Covariances with the market calculated from daily using a 30 trading day rolling window. Plot shows monthly averages. Monthly data 1973-2022.



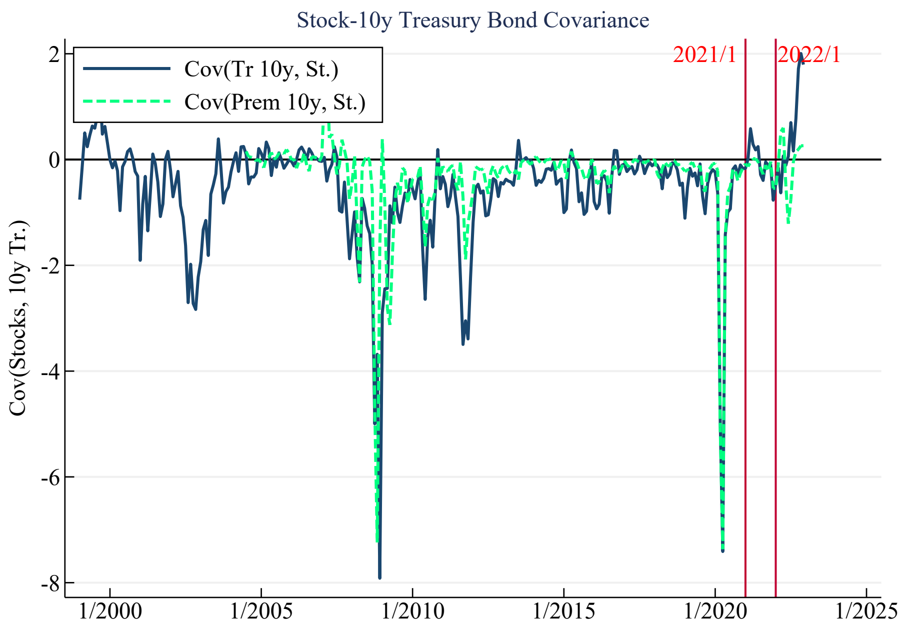


Figure 4: TIPS-Treasury premium. Stock-Bond Covariance Using the TIPS-Treasury Premium. Top panel shows a scatterplot of TIPS-Treasury premium and the aggregate stock-bond covariance. TIPS-Treasury premium residualized with respect to the effective Fed funds rate.

Bottom panel shows two calculations of the stock-bond covariance in a 30 trading day rolling window, averaged to a monthly value. The blue solid shows the calculation using the 10-year Treasury yield. The neon dashed line shows the calculation using the 10-year TIPS-Treasury premium to construct the bond return.

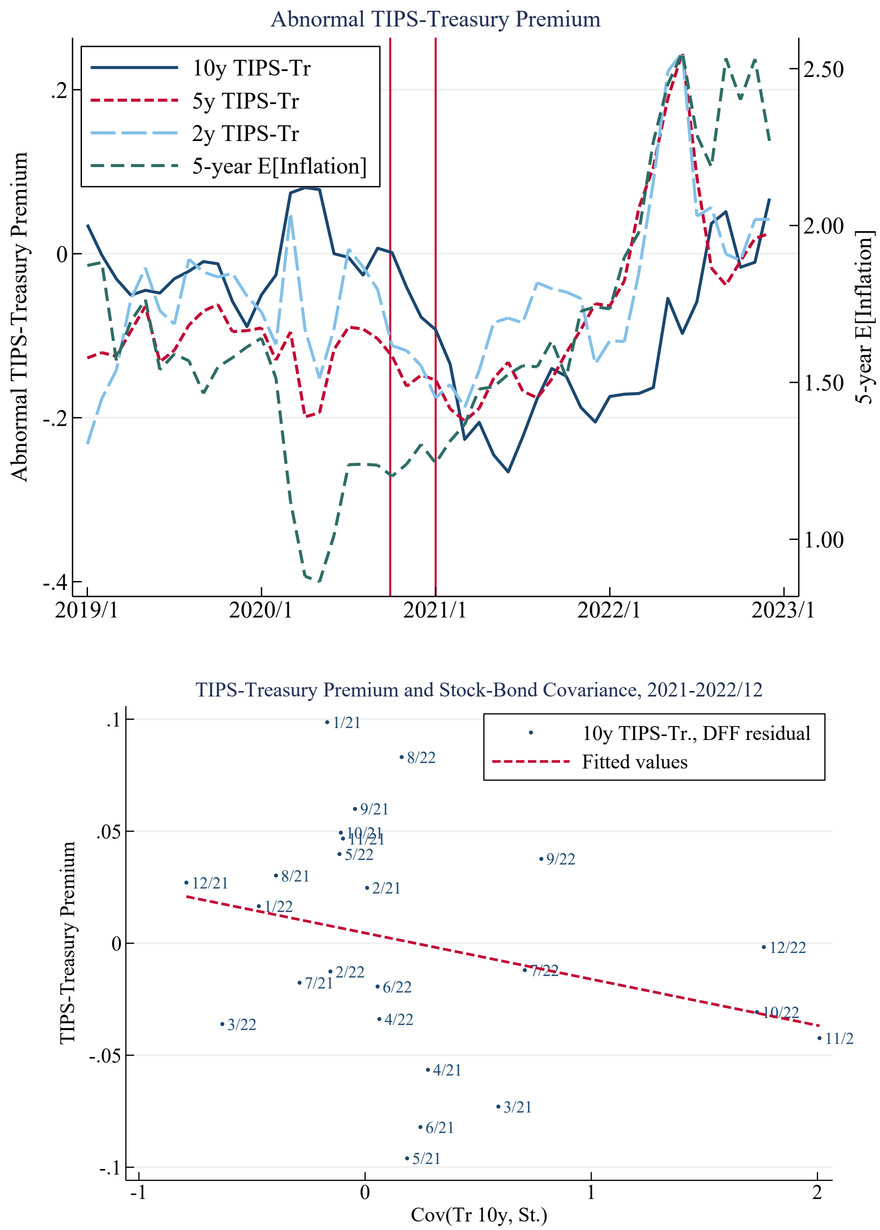
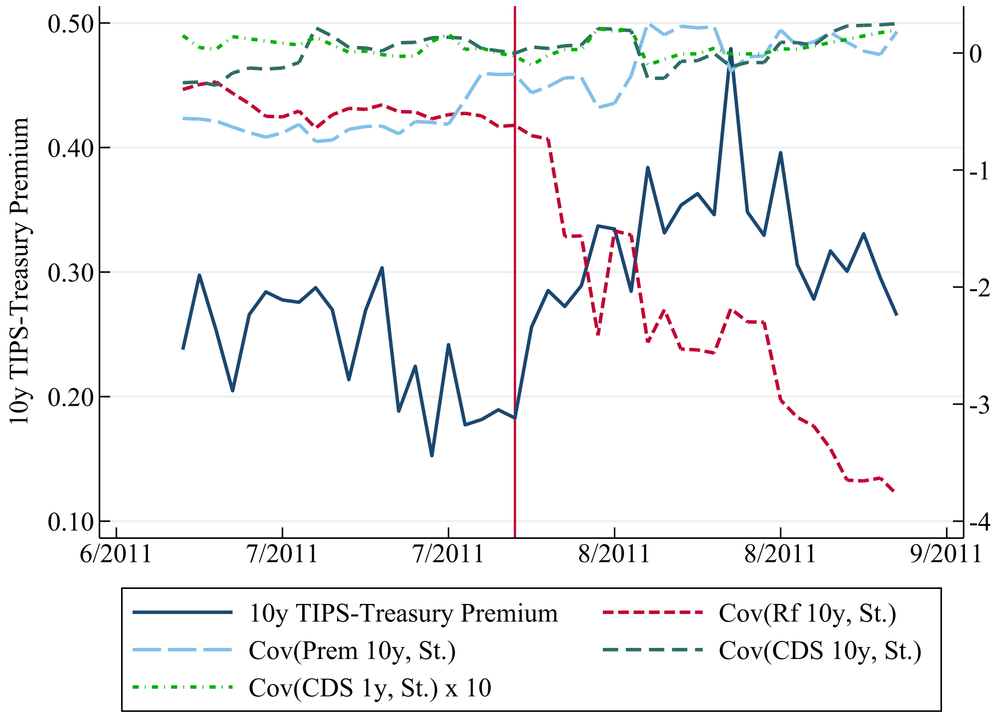


Figure 5: TIPS-Treasury Premium and the Stock-Bond Covariance. Monthly data 2020-22. The top panel shows the level of the TIPS-Treasury premium; the bottom panel shows a scatterplot of the TIPS-Treasury premium and stock-bond covariance. TIPS-Treasury premium residualized with respect to effective Fed Funds rate.



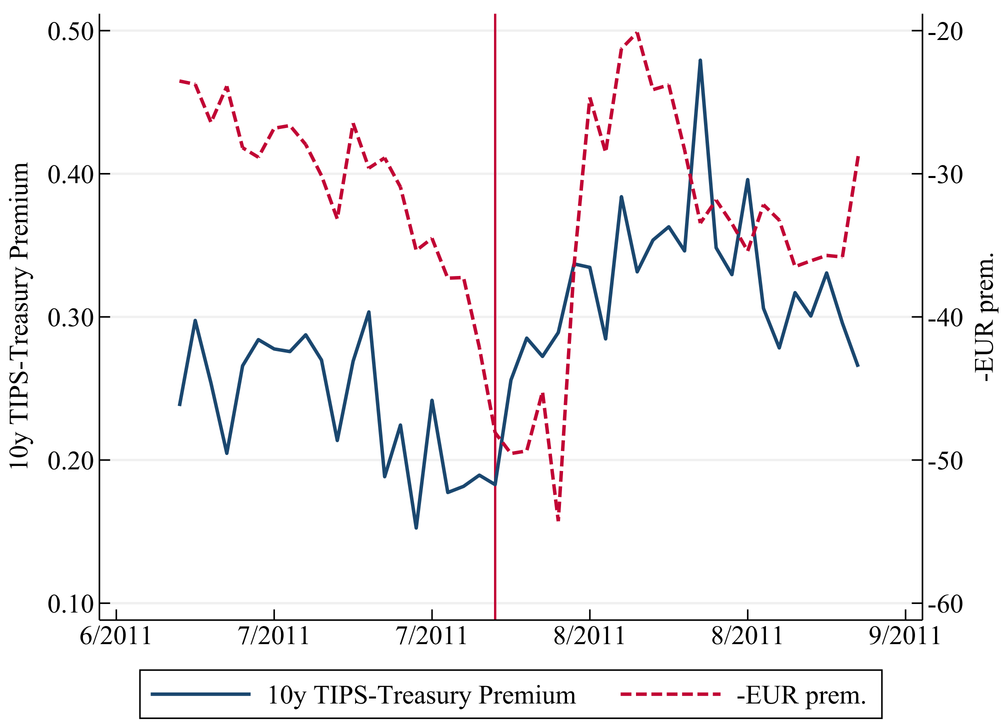


Figure 6: TIPS-Treasury Premium and the Stock-Bond Covariance around the 2011 Debt Ceiling Crisis. Relative Treasury Convenience Yield over German Government Bonds. Top panel shows the TIPS-Treasury premium and the stock-bond covariance. Bottom panel shows the relative convenience yield of US Treasuries over German government bonds. Red vertical lines indicate August 1, 2011.

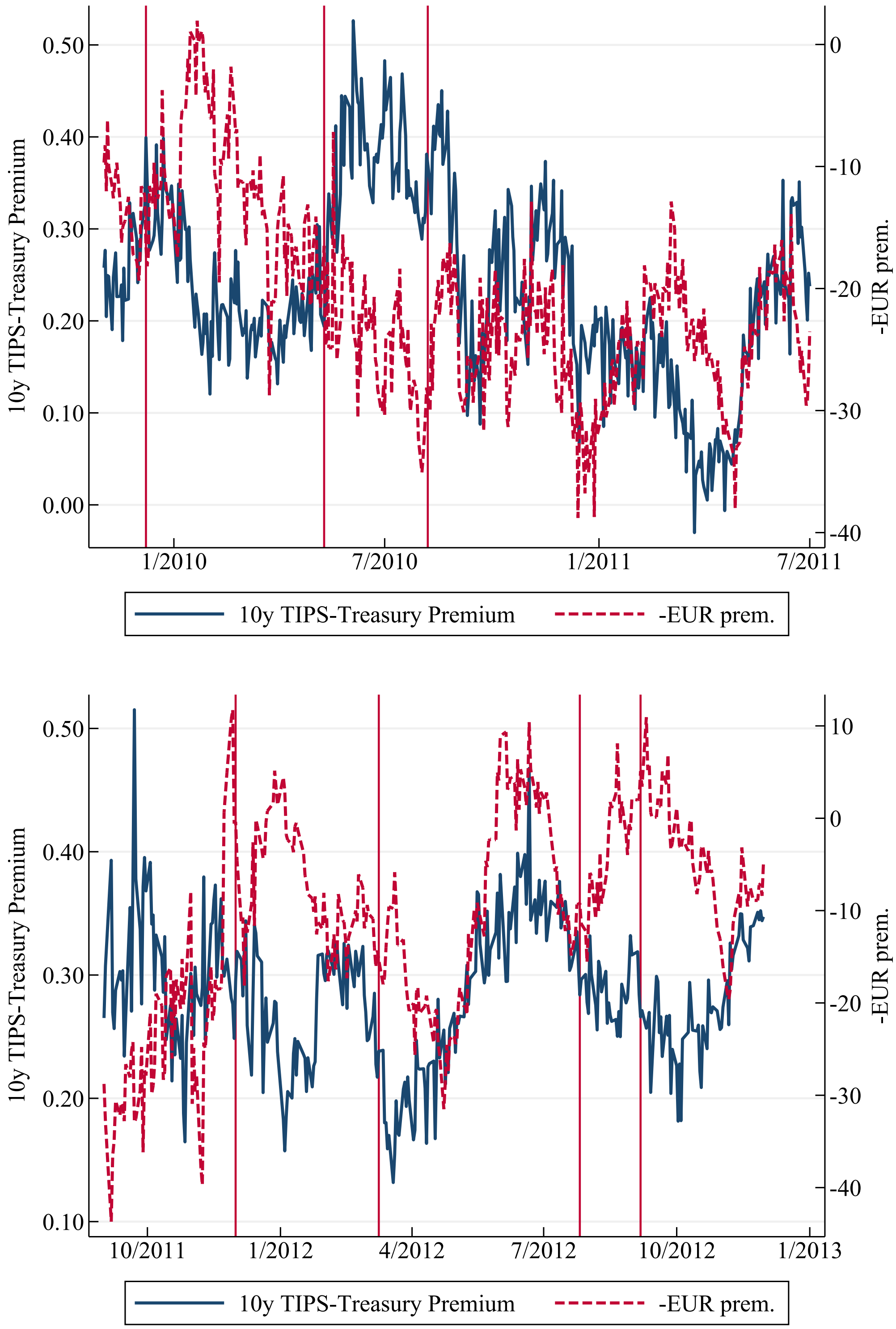


Figure 7: TIPS-Treasury Premium and Relative Treasury Convenience Yield of German Government Bonds. 12/8/2009, 5/10/2010, and 8/7/2010 indicated in top panel. 12/1/2011, 3/9/2012, 7/26/2012, 9/6/2012 indicated in bottom panel.

9 Online Appendix

Panel A.

	2005-2022			
	Cov(Tr 10y, St.)	Cov(Prem. 10y, St.)	Cov(Rf 10y, St.)	Cov(CDS 10y, St.)
L.Cov(Tr 10y, St.)	0.71***			
	(14.36)			
L.Cov(Prem. 10y, St.)		0.59***		
		(10.77)		
L.Cov(Rf 10y, St.)			0.39***	
			(6.00)	
L.Cov(CDS 10y, St.)				0.55***
				(9.66)
Constant	-0.17***	-0.14**	-0.17***	0.02*
	(-2.70)	(-2.48)	(-3.02)	(1.70)
Observations	215	215	215	215
R^2	0.492	0.352	0.145	0.305

Table 9: Autocorrelation coefficients of the Aggregate Stock-Bond Covariance Components. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A.

	2005-2022					
	F.10y TIPS-Tr	F.GC-Tr 3m	F.FF-Tr 3m	F.-1*Z-spr.	F.P2-Tr.	F.AAA-Tr.
Cov(Tr 10y, St.)	-0.07**	-0.03**	-0.06*	-0.03	-0.37***	-0.10***
	(-2.13)	(-1.97)	(-1.65)	(-1.20)	(-2.92)	(-4.21)
Eff. Fed Funds	0.02**	0.03**	0.06**	0.01	0.12***	-0.08***
	(2.32)	(2.46)	(2.03)	(0.83)	(3.00)	(-5.56)
Constant	0.22***	0.08***	-0.04	0.11***	0.22***	1.05***
	(11.16)	(3.85)	(-1.08)	(5.94)	(4.12)	(20.56)
Observations	215	215	215	215	215	215
R^2	0.268	0.176	0.163	0.059	0.323	0.472

Panel B.

	1991-2022				
	F.GC-Tr 3m	F.FF-Tr 3m	F.-1*Z-spr.	F.P2-Tr.	F.AAA-Tr.
Cov(Tr 10y, St.)	-0.03**	-0.06*	-0.03	-0.37***	-0.10***
	(-1.97)	(-1.65)	(-1.20)	(-2.92)	(-4.21)
Eff. Fed Funds	0.03**	0.06**	0.01	0.12***	-0.08***
	(2.46)	(2.03)	(0.83)	(3.00)	(-5.56)
Constant	0.08***	-0.04	0.11***	0.22***	1.05***
	(3.85)	(-1.08)	(5.94)	(4.12)	(20.56)
Observations	215	215	215	215	215
R^2	0.176	0.163	0.059	0.323	0.472

Panel C.

	1972-2022			
	F.FF-Tr 3m	F.-1*Z-spr.	F.P2-Tr.	F.AAA-Tr.
Cov(Tr 10y, St.)	-0.06	-0.03	-0.37***	-0.10***
	(-1.63)	(-1.20)	(-2.92)	(-4.21)
Eff. Fed Funds	0.08***	0.01	0.12***	-0.08***
	(2.87)	(0.83)	(3.00)	(-5.56)
Constant	-0.05	0.11***	0.22***	1.05***
	(-1.19)	(5.94)	(4.12)	(20.56)
Observations	215	215	215	215
R^2	0.250	0.059	0.323	0.472

Table 10: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. Left hand side variables are proxies of the convenience yield. The selection of left hand side variables in each panel reflects their availability in the indicated time period. Right hand side variables are the monthly stock-bond covariance and the effective Fed Funds rate. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

	2005-2022					
	F.10y TIPS-Tr	F.GC-Tr 3m	F.FF-Tr 3m	F.-1*Z-spr.	F.P2-Tr.	F.AAA-Tr.
Cov(Prem. 10y, St.)	-0.09**	-0.03	-0.04	-0.04	-0.49**	-0.11***
	(-2.08)	(-1.50)	(-1.50)	(-1.31)	(-2.48)	(-3.61)
Cov(Rf 10y, St.)	-0.05*	-0.05**	-0.11*	-0.02	-0.24***	-0.11***
	(-1.81)	(-2.26)	(-1.72)	(-0.89)	(-3.13)	(-5.69)
Cov(CDS 10y, St.)	-0.22*	-0.19***	-0.24*	-0.14	-0.95***	-0.44***
	(-1.65)	(-3.18)	(-1.90)	(-1.37)	(-2.84)	(-3.42)
Eff. Fed Funds	0.01**	0.03**	0.05**	0.01	0.12***	-0.09***
	(2.15)	(2.37)	(1.98)	(0.77)	(2.89)	(-5.73)
Constant	0.23***	0.08***	-0.04	0.11***	0.24***	1.06***
	(10.93)	(4.18)	(-1.06)	(6.30)	(3.79)	(20.79)
Observations	215	216	216	215	215	216
R^2	0.325	0.211	0.205	0.088	0.406	0.508

Table 11: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. Left hand side variables are proxies of the convenience yield. 10-year Treasury yield split into the convenience yield, the risk-free yield and the CDS yield. Right hand side variables are the rolling stock-bond covariances estimated using these two constituent yields and the effective Fed Funds rate. Monthly data 2005-2022. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A.

	2005-2022		
	2y TIPS-Tr	5y TIPS-Tr	10y TIPS-Tr
Cov(Tr 2y, St.)	-0.74***		
	(-3.35)		
Cov(Tr 5y, St.)		-0.20***	
		(-2.81)	
Cov(Tr 10y, St.)			-0.06**
			(-2.23)
Eff. Fed Funds	0.01	0.03***	0.01**
	(0.78)	(4.30)	(2.08)
Constant	0.19***	0.19***	0.23***
	(8.06)	(8.23)	(11.51)
Observations	216	216	216
R^2	0.381	0.336	0.225

Panel B.

	2005-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y, St.)	-0.07**	-0.04***	-0.07**	-0.04	-0.49***	-0.11***
	(-2.37)	(-2.91)	(-2.12)	(-1.45)	(-3.01)	(-5.14)
Cov(Tr 3m, St.)	0.53*	-0.39	-2.12*	0.05	0.41	0.41
	(1.90)	(-0.85)	(-1.91)	(0.15)	(0.21)	(0.71)
Eff. Fed Funds	0.02**	0.03***	0.04*	0.01	0.11***	-0.09***
	(2.44)	(2.64)	(1.96)	(0.84)	(3.37)	(-6.15)
Constant	0.23***	0.07***	-0.04	0.10***	0.16**	1.05***
	(11.49)	(3.58)	(-1.17)	(5.36)	(2.09)	(21.16)
Observations	216	216	216	216	216	216
R^2	0.239	0.240	0.260	0.114	0.552	0.547

Table 12: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. In Panel A, the left hand side variables are the TIPS-Treasury premium at different maturities and the right hand side variables are the stock-bond covariances calculated using the corresponding maturity Treasury. In Panel B the left hand side variables are proxies of the convenience yield. Right hand side variables are stock-bond covariances calculated using 10 year and 3 month Treasury yields. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Panel A.

	2005-2022					
	10y TIPS-Tr	GC-Tr 3m	FF-Tr 3m	-1*Z-spr.	P2-Tr.	AAA-Tr.
Cov(Tr 10y LW, St.)	-0.05*	-0.03**	-0.05*	-0.04*	-0.40***	-0.08***
	(-1.88)	(-2.15)	(-1.77)	(-1.77)	(-2.66)	(-3.74)
Eff. Fed Funds	0.01	0.03**	0.05**	0.00	0.09***	-0.09***
	(1.21)	(2.42)	(2.10)	(0.18)	(3.21)	(-6.74)
Constant	0.24***	0.08***	-0.01	0.10***	0.20**	1.07***
	(11.64)	(3.90)	(-0.28)	(5.42)	(2.57)	(20.92)
Observations	204	204	204	204	204	204
R^2	0.197	0.213	0.199	0.217	0.547	0.535

Table 13: Stock-Bond Covariance and Proxies of the Treasury Convenience Yield. Left hand side variables are proxies of the convenience yield. The selection of left hand side variables in each panel reflects their availability in the indicated time period. Right hand side variables are the monthly stock-bond covariance and the effective Fed Funds rate. Heteroskedasticity robust standard errors in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

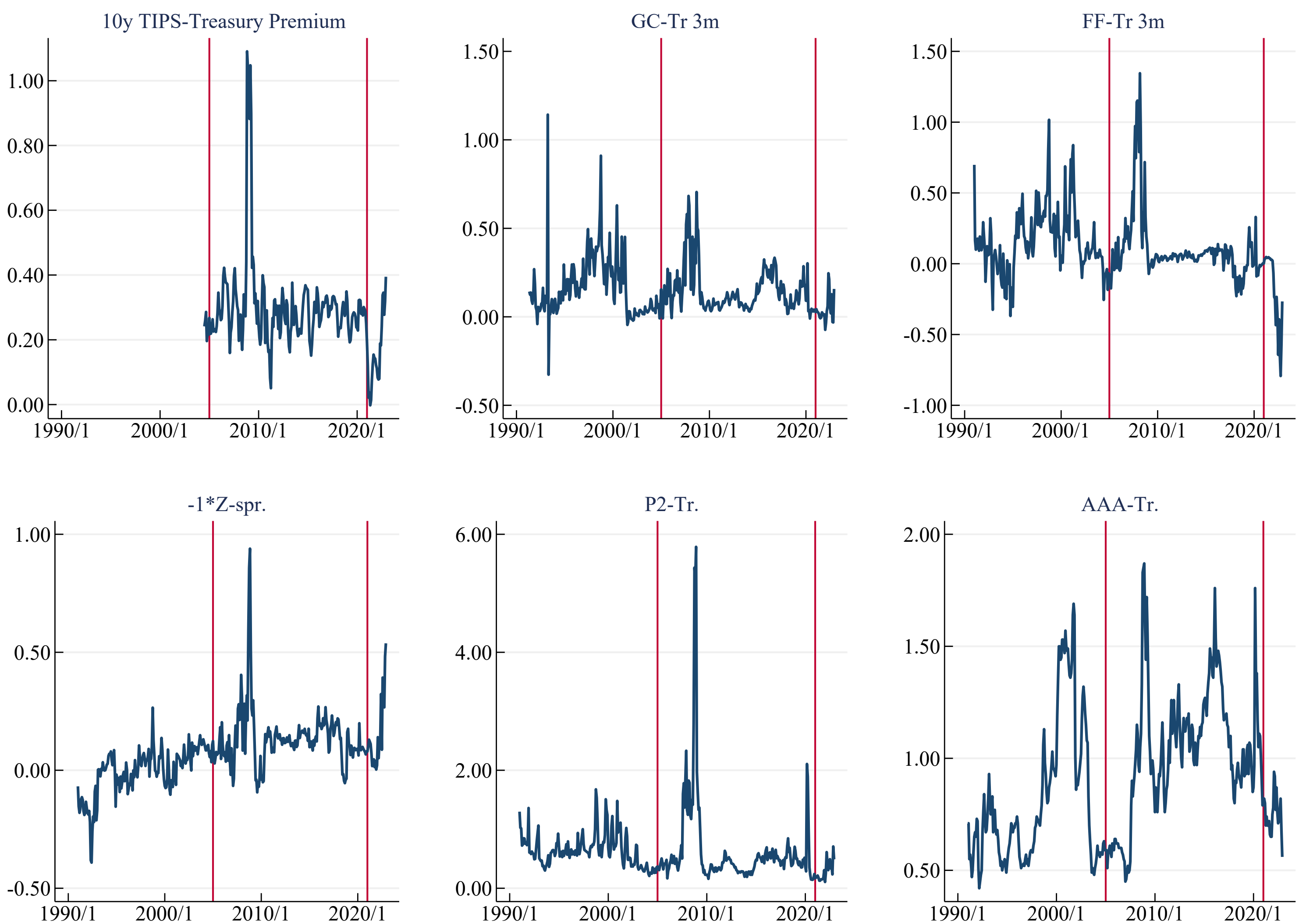


Figure 8: Proxies of the Treasury Convenience Yield. Monthly data 1/1991 to 12/2022. Vertical lines indicate 1/2005 and 1/2021.