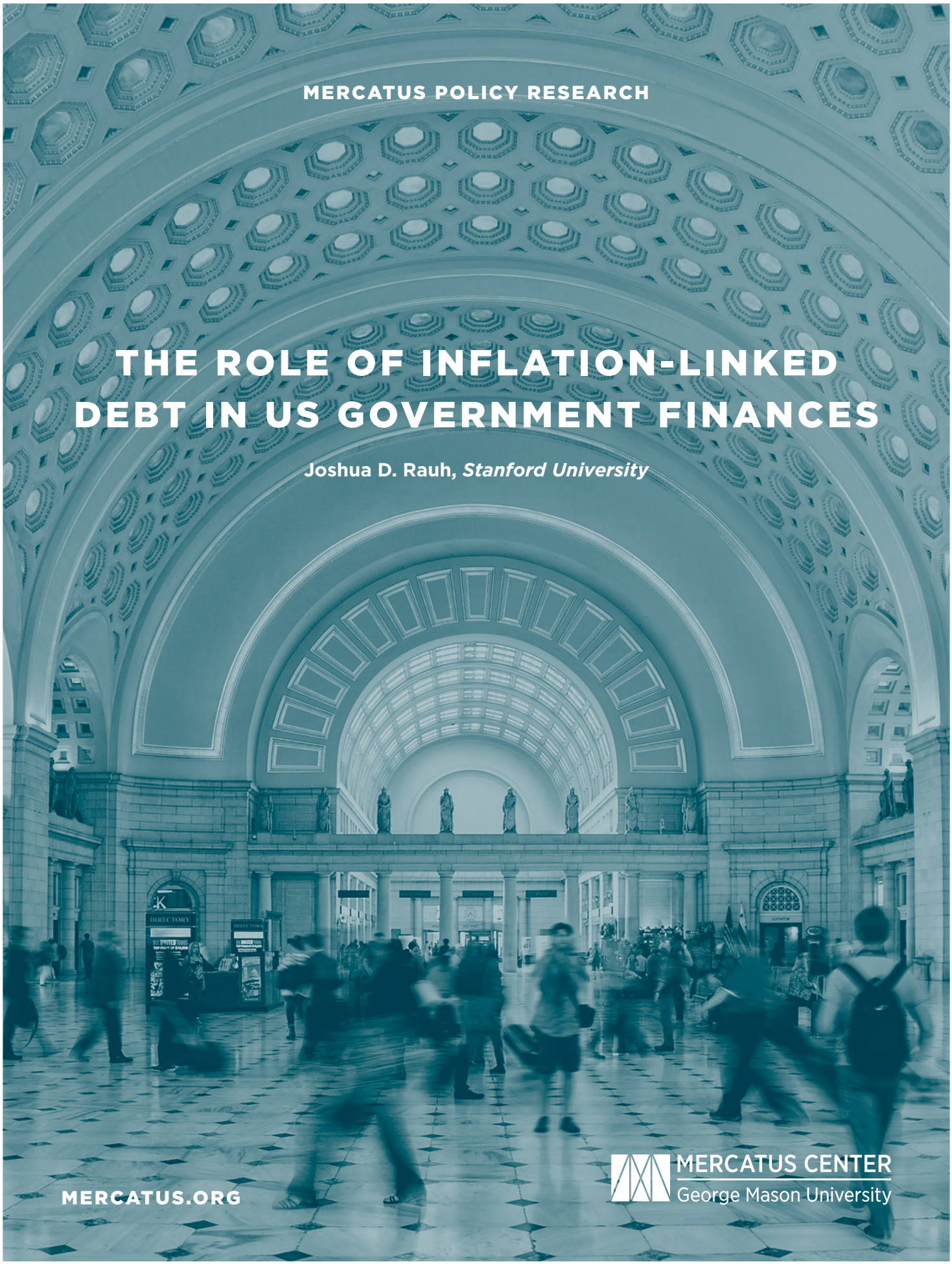

MERCATUS POLICY RESEARCH

THE ROLE OF INFLATION-LINKED DEBT IN US GOVERNMENT FINANCES

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ABSTRACT

Evidence of a liquidity penalty on Treasury Inflation-Protected Securities (TIPS) is often cited as a reason the Treasury should eschew the issuance of inflation-protected securities. Conventional wisdom has been that this liquidity cost more than offsets the benefit to the Treasury of not having to pay higher yields to compensate investors for an inflation risk premium. This paper reviews the use of inflation-linked debt by the US government in the form of both the TIPS program and the much smaller I bond program. While the liquidity penalty has not decreased, the once-prominent gap between break-even inflation rates implied by the TIPS-Treasury spread and several measures of inflation expectations has narrowed dramatically since 2021. This finding implies that the inflation risk premium has increased to a point where it is nearly large enough to outweigh the liquidity penalty, making a case for the Treasury to monitor the inflation risk premium and increase TIPS issuance if the inflation risk premium remains elevated. The case would be even stronger if the Treasury were to undertake simple measures to increase the liquidity of inflation-linked debt. If the government actually wishes to limit the stealth tax represented by inflation, it can do so by raising the share of inflation-indexed debt and making such debt more liquid.

JEL codes: E43, E62, E63, H62, H63

Keywords: inflation-indexed debt, Treasury Inflation-Protected Securities, TIPS, fixed income, break-even inflation, liquidity premium

The rise in inflation that began in mid-2021 has led to renewed interest in investment instruments capable of protecting investors against unexpected price increases. This attention to inflation-indexed assets, in turn, raises the question of the role of inflation-linked debt in government finances.

The US Treasury issues two main types of inflation-indexed debt instruments: Treasury Inflation-Protected Securities (TIPS) and Series I savings bonds (I bonds). Both programs are small compared to the overall magnitude of marketable US government debt. As of February 2023, TIPS outstanding amounted to $1.88 trillion, or 6 percent of US government debt. While I bonds saw inflows of $34.8 billion in the 12 months leading to February 2023, their total outstanding value amounted to $94.7 billion, a minuscule 0.3 percent of US government debt, presumably owing in large part to the $10,000 per-investor cap on purchases. Despite periods of excitement regarding their potential to protect from inflation, TIPS have never risen to more than around 10 percent of the outstanding debt of the US federal government. Yet investor demand for inflation-protected investments naturally increases with inflation expectations.

This paper reviews the role of inflation-indexed debt in US government finances, including the costs and benefits of issuing more inflation-indexed Treasury bonds under existing structures. It also makes recommendations for modifying these structures to make expanded issuance of inflation-linked debt more appealing to both investors and a taxpayer-representative government. The fact that the federal government has not issued more inflation-linked debt in the past has contributed to keeping current interest costs lower during a period of increased inflation. However, the important question for policy now is not looking ex post at the interest the government would have paid had it had more inflation-linked debt, but rather at the ex ante costs of inflation-linked debt versus nominal Treasury bonds.[1]

1. See also William C. Dudley, Jennifer Roush, and Michelle Steinberg Ezer, "The Case for TIPS: An Examination of the Costs and Benefits," *Federal Reserve Bank of New York Economic Policy Review* 15, no. 1 (July 2009): 1–17.

When the Treasury began issuing inflation-indexed bonds in the 1990s, many economists and market analysts heralded the step. In addition to the point that inflation-indexed bonds protect investors from inflation uncertainty more than any other asset available in the market, the Treasury also hoped for substantial yield savings from not having to compensate investors for an inflation risk premium as it does in nominal bonds. Furthermore, a liquid market for inflation-indexed debt reveals information about the market's inflation expectations, which observers hoped would be useful to the Federal Reserve and policymakers more generally.[2]

In recent years, however, research in financial economics has identified important costs of the issuance of inflation-indexed debt by the US Treasury, particularly through the TIPS program. TIPS command lower prices than so-called synthetic versions of TIPS consisting of a nominal Treasury bond plus a market-priced swap of fixed payments for inflation-linked payments.[3] This lower pricing likely reflects the fact that the Treasury is able to issue nominal bonds at a particularly low yield because of money-like properties that TIPS do not enjoy, including deep market liquidity and convenience. Hence, by issuing TIPS, the Treasury both leaves this convenience yield on the table and subjects the budget to higher interest payments during inflationary times. These liquidity factors may also vary over time.[4] Furthermore, the tax treatment of TIPS is complex, involving annual taxation of what are effectively unrealized taxable gains in the inflation-linked principal increases. This tax treatment means that the Treasury Department must offer a higher real interest rate component on issued TIPS to generate demand for a given issue size. These unforeseen burdens have offset some of the potential benefits to both investors and the Treasury Department.

If the Treasury holds the convenience yield on nominal Treasury bonds fixed (for the cost calculation to reverse and point to budgetary efficiency of inflation-linked debt), investor interest in the insurance properties of inflation-linked debt would have to be so large as to overcome the liquidity headwinds. Given the low inflation environment most of the world has experienced in the past few decades, this shift in investor expectations did not materialize over the period of low inflation. In this paper, however, I provide evidence that such a shift has occurred recently.

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2. Pu Shen, "Benefits and Limitations of Inflation Indexed Treasury Bonds," *Economic Review, Federal Reserve Bank of Kansas City* 80, no. 3 (July 1995): 41–56.
3. Matthias Fleckenstein, Francis A. Longstaff, and Hanno Lustig, "The TIPS-Treasury Bond Puzzle." *Journal of Finance* 69, no. 5 (October 2014): 2151–97.
4. Shen, "Benefits and Limitations of Inflation Indexed Treasury Bonds."

While there remains a clear liquidity-driven yield penalty for TIPS, as of the latest data, break-even inflation rates in marketable inflation-linked government bonds are close to or exceed the level of consumer inflation expectations in the short end of markets in both the United States and the United Kingdom.[5] This is also the case in the longer end of the US market if professional inflation forecasts are used, though not if consumer expectations are used. Findings of break-even inflation rates roughly meeting surveyed inflation expectations contrast with the previous period in which the TIPS-Treasury break-even rate was generally considerably lower than expected inflation, so investors did better by buying TIPS even when inflation fell considerably short of their actual expectations. This shift provides evidence that the inflation risk premium has risen, making even the less liquid TIPS a plausibly beneficial source of financing for the US government. Investors now break even only at realized inflation rates that are much closer to actual inflation expectations, as opposed to making money.

Furthermore, the lack of a highly liquid market for inflation-linked debt is not an inherent characteristic of such debt but instead is a policy choice. Legislation could easily make TIPS more liquid through several basic changes, including changes in their tax treatment. Moreover, a more stable index to track inflation would substantially reduce the short-term swings in principal value that can result from using the CPI-U, the Consumer Price Index for all urban consumers. One inflation-linked program that has many of these constraints removed is the I bonds program. However, the program's cap and lack of marketability limit the ability of investors to take advantage of these securities. Removing these and other constraints on inflation-linked debt programs might actually give such issued securities the money-like properties that they have lacked and that investors desire.

With many of the program's costs being self-imposed, there must be some consideration of why a well-functioning inflation-linked debt program is not a policy objective. The common argument is that it increases long-term fiscal burdens, particularly during inflationary periods. Yet this need not be a disadvantage. In fact, it is often underemphasized in the discussion of inflation-linked

5. Andrey Ermolov, "When and Where Is It Cheaper to Issue Inflation-Linked Debt?" *Review of Asset Pricing Studies* 11, no. 3 (September 2021): 610–53. Ermolov compares experiences across countries in data from Canada, France, Sweden, the United Kingdom, and the United States before the latest inflationary episode and finds that, on average, it has been cheaper to issue nominal debt at medium-term tenors (5 to 10 years) and inflation-linked debt at longer-term tenors (20 or more years). However, outside the United States, the liquidity impact of convenience yields on nominal debt is likely substantially smaller than inside the United States, given the dollar's role as a reserve currency and the important role of US Treasury bonds in international financial markets.

debt that such a program can play a disciplinary role in government finances. Inflation indexation of government debt has long been understood to remove the incentive for the government to pay off its debts with inflated money.[6,7] With more inflation-linked debt, rising inflation-linked interest costs would necessitate budgetary action to reduce debt. This disciplinary action could by itself encourage the government to run smaller deficits and ultimately lead to less inflation, especially given the role that fiscal policy plays in determining the price level.[8]

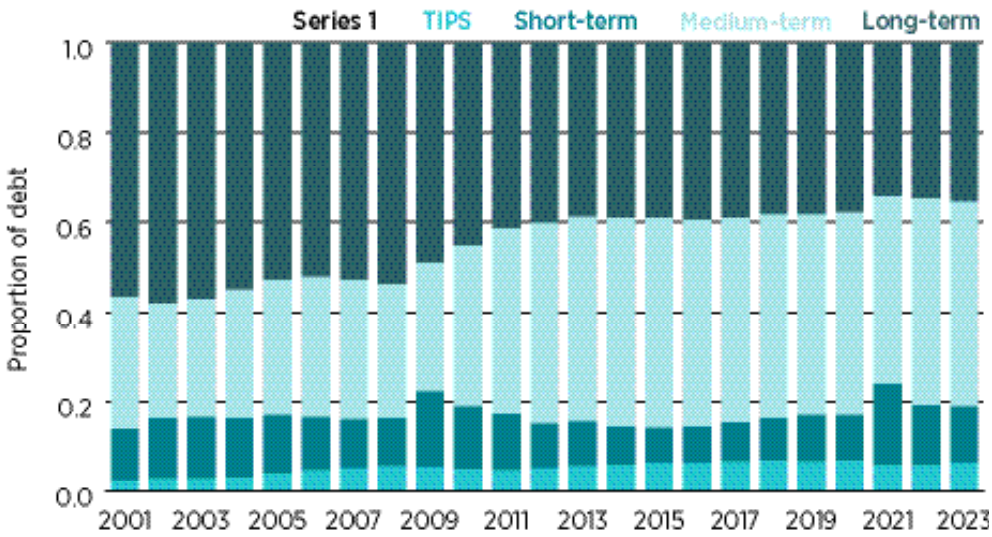
A majority of Americans (56 percent) said in a Gallup poll conducted in August 2022 that inflation was a hardship for them and their families; among the poorest Americans, this number is closer to 74 percent.[9] If US policymakers cannot provide that protection to the hard-earned savings of average Americans and simultaneously reduce the effect of their own spending habits on inflation, then these self-destructive tendencies will have increasing economic costs.

THE COMPOSITION OF US GOVERNMENT DEBT AND INFLATION EXPOSURE

Most US government debt is in the form of nonindexed Treasury bonds. Figure 1 shows the breakdown of US government debt that is inflation indexed versus nominal, and among nominal bonds, the percentage that is short term, from 2001 to the present. As of February 2023, 35 percent of US government debt was in the form of long-term Treasuries (maturity of 10 years or longer), 45.7 percent in the form of medium-term Treasuries (maturity between 10 years and 1 year), 13 percent in the form of short-term debt (maturity of less than 12 months), and

6. Robert Price, "The Rationale and Design of Inflation-Indexed Bonds" (IMF Working Paper No. 1997/012, International Monetary Fund, Washington, DC, January 1, 1997); Henning Bohn, "Why Do We Have Nominal Government Debt?" *Journal of Monetary Economics* 21, no. 1 (January 1988): 127–40. Price further provides arguments for the rationale and design of inflation-indexed bonds. Bohn finds it worth asking why governments issue nominal debt at all, answering that under distortionary taxation, nominal debt does provide insurance against the budgetary effects of economic fluctuations.
7. G.L. Bach and Robert A. Musgrave, "A Stable Purchasing Power Bond," *American Economic Review* 31, no. 4 (December 1941): 823–25; Guillermo A. Calvo, "On the Time Consistency of Optimal Policy in a Monetary Economy," *Econometrica* 46, no. 6 (November 1978): 1411–28; Robert E. Lucas and Nancy L. Stokey, "Optimal Fiscal and Monetary Policy in an Economy without Capital," *Journal of Monetary Economics* 12 (1983): 55–93.
8. John H. Cochrane, *The Fiscal Theory of the Price Level* (Princeton: Princeton University Press, 2022); John H. Cochrane, "Fiscal Histories," *Journal of Economic Perspectives* 36, no. 5 (Fall 2022): 125–46.
9. Jeffrey M. Jones, "Inflation Now Causing Hardship for Majority in U.S.," Gallup News, September 7, 2022, https://news.gallup.com/poll/400565/inflation-causing-hardship-majority.aspx.

FIGURE 1. PROPORTION OF OUTSTANDING DEBT BY MATURITY

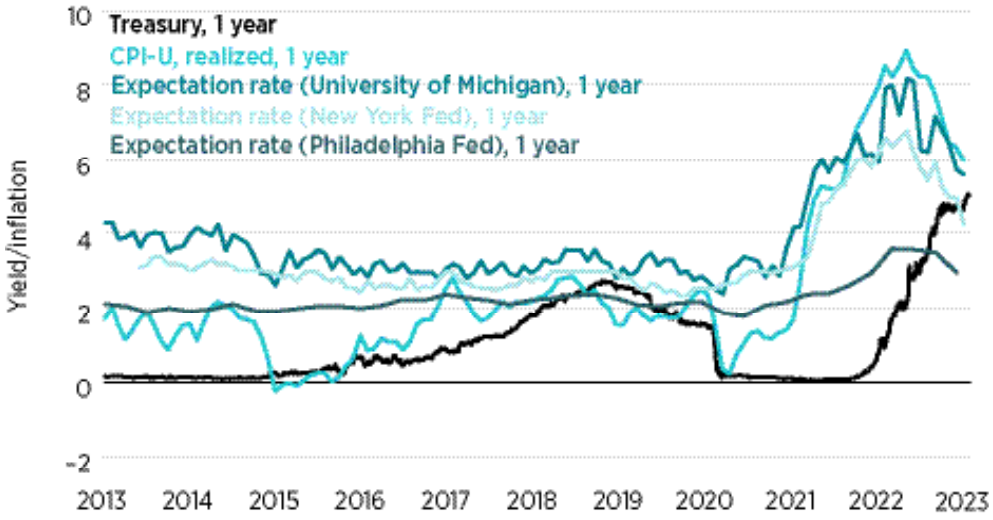


Source: Data were obtained from the US Treasury Monthly Statement of the Public Debt, January 2001 through February 2023, end of calendar year (except 2023, which is as of February 28, 2023).

6 percent in TIPS. I bonds are barely visible in figure 1, comprising only 0.3 percent of government debt.

The longer the maturity of a nominal bond, the more inflation risk to which investors are exposed—and, in particular, to the risk of unexpected inflation—because investors logically demand compensation in the form of higher yields at the time of issue for expected inflation over the maturity horizon of the bond. Shorter-term bonds also carry this risk of diminished purchasing power, as evidenced by the experience of any investor who bought short-term Treasury bonds from mid-2021 through mid-2022. The one-year Treasury yield on June 30, 2021, was 0.07 percent, compared to realized inflation in the year to June 30, 2022, of 9.00 percent. In the theory of a free market for securities, as inflation expectations rise, so should market yields on the newly issued instruments, although the Federal Reserve's interventions in the Treasury market and setting of short-term interest rates may prevent this from happening. Figure 2 shows that the New York Fed's measure of inflation expectations in the past decade has generally surpassed the one-year Treasury yield over the past decade. Short-term bonds seem to offer limited inflation protection for investors, particularly as a result of bouts of unexpected inflation.

FIGURE 2. EXPECTED AND ACTUAL INFLATION VERSUS TREASURY YIELDS



Sources: Expectation data were obtained from the Federal Reserve Bank of New York's Survey of Consumer Finances, University of Michigan's Survey of Consumer Finances, and the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters. CPI-U and Treasury yields obtained from the Federal Reserve.

Note: Data are through February 2023.

Treasury Inflation-Protected Securities

In the mid-1990s, the Clinton administration was searching for methods to offer average American depositors a way to retain the real value of their savings. Starting in spring 1996, the Treasury Department began a public comment period in which recommendations regarding a new index-linked security would be accepted.[10] Although the template would be based around principal adjustments according to some inflation index, the nature of that index and the inclusion of a nonzero real interest rate were not necessarily settled issues. The process of public input culminated by the end of September with a proposed set of modifications to 31 C.F.R. § 356, the product of which was a security with

10. Amendments to the Uniform Offering Circular for the Sale and Issue of Marketable Book-Entry Treasury Bills, Notes and Bonds," 61 Fed. Reg. 25164–25173, (May 29, 1966) (to be codified at 31 C.F.R. pt. 356).

remarkable resemblance to both Canada's Real Return Bonds (whose issuance was ceased in November 2022) and the United Kingdom's index-linked gilts.[11]

In the new TIPS program, the principal would be adjusted according to the Department of Labor's CPI-U, lagged three months from the issue date (31 C.F.R. § 356.B). Thus, the ratio between the CPI-U index three months before the current date and three months before issuance would be the factor inflating (or deflating) the principal. The fixed interest rate would then be applied semiannually to the adjustable principal to produce a stream of income that was constant in real terms (even if it differed in nominal terms).

Notable about this new type of bond was the promise of partial protection against deflation; should there be a period of sustained deflation throughout the security's horizon, the nominal principal would be repaid if it is larger than the real principal (31 C.F.R. § 356.30). The tax treatment of TIPS was defined to include coupon payments as taxable income, as well as the level of principal adjustments in the year the adjustments happen; that is, the adjustments that occur to the principal trigger an immediate tax liability even though the investor has not actually realized a capital gain. With these regulations in place, the Treasury first issued TIPS in January 1997, and many economists commented on and began to study the market.[12]

The TIPS program was explicitly designed to protect investors against inflation through principal that is indexed to the change in prices. Thus, although TIPS coupon rates do not adjust with inflation because the coupon rate itself is applied to a higher (lower) base when CPI-U rises (falls), the real value of both the interest payment and the principal are protected. To determine the real size of these interest payments over the lifetime of the security, TIPS bonds are quoted at the real yield and are expected to deliver that real yield plus expected inflation. A standard decomposition of the yield on nominal Treasury securities into its components shows that the yield on a nominal security of a given horizon reflects the real yield plus compensation for expected inflation plus an inflation risk premium:

$$\text{Nominal Yield} = \text{Real Yield} + \text{Expected Inflation} + \text{Inflation Risk Premium} \quad (1)$$

11. Sale and Issue of Marketable Book-Entry Treasury Bills, Notes, and Bonds" (Department of the Treasury Circular, Public Debt Series No. 1–93), 61 Fed. Reg. 50924–50929 (September 27, 1996) (to be codified at 31 C.F.R. pt. 356).

12. Richard Roll. "Empirical TIPS," *Financial Analysts Journal* 60, no. 1 (January/February 2004): 31–53; Richard Roll, "U.S. Treasury Inflation-Indexed Bonds: The Design of a New Security," *Journal of Fixed Income* 6, no. 3 (December 1996): 9–28. For example, in one early contribution, Roll (1996, 9) highlights that the "central conundrum here, as with any security's design, is that trade-off between broad market liquidity and specific structures that appeal to clientele groups." Later, Roll (2004) analyzes the role of TIPS in investor portfolios and the factors driving the changes in their pricing over time.

Equation (1) assumes that the nominal yield and real yield are measured using instruments with similar liquidity—an assumption that will likely not be valid if comparing yields on nominal Treasury bonds to TIPS yields.

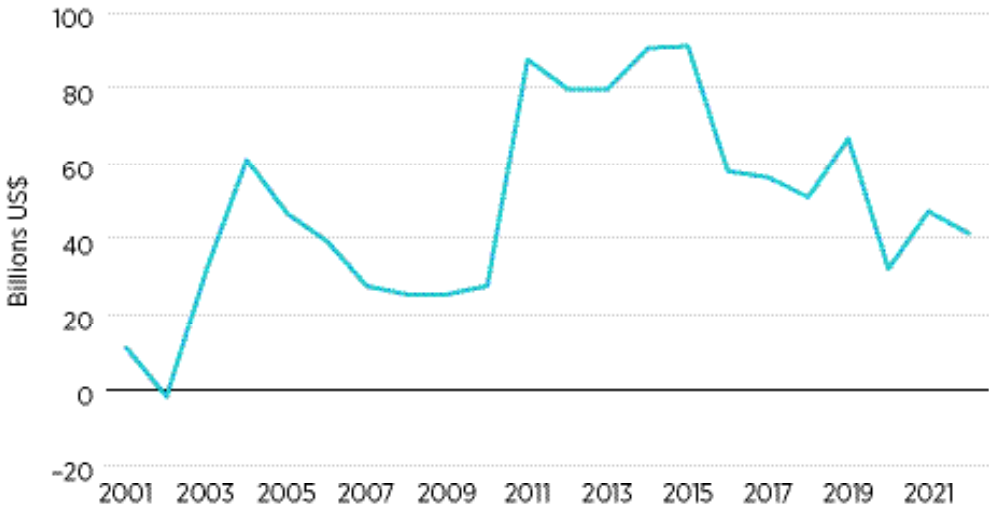
As explained earlier, TIPS are also, to some extent, protected against deflation. Although negative realizations of the CPI-U reduce TIPS principal, the face value is guaranteed never to fall below its original value at issuance. Thus, outstanding TIPS bonds with substantial embedded increases in face value will see those increases reversed during a deflationary period, but only until the face value of the bond falls to the original value at issuance. Given these features, TIPS are clearly a long-run inflation hedge, but in the short term, they do not serve investors looking for inflation protection for two reasons.

First, the CPI-U is a fairly poor measure of inflation in the short term. Shoemaker finds that standard errors increase on a relative basis (standard error divided by price change) as the price change interval gets shorter.[13] Holding TIPS to hedge against inflation in the short term therefore is subject to the increased variability of CPI-U measurement. The Treasury Borrowing Advisory Committee, a group of private investors who confer with the Treasury Department about debt issuance, has voiced such volatility concerns since at least 2009.[14] The fact that the indexation of TIPS bonds is based on CPI-U inflation three months in advance also reduces the hedging properties of TIPS and leads to a stale link. Practically, this feature also has the effect that the inflation hedging of TIPS ends three months before the maturity of the bond, effectively turning it into a Treasury bill for the final three months.[15]

Second, as real interest rates increase, the value of a portfolio of long-term TIPS declines owing to the realization of interest rate risk. These losses are recovered as the bonds mature, but this recovery requires holding the bonds to maturity. For this reason, exchange-traded funds (ETFs) that hold portfolios of TIPS declined substantially in value over the first half of 2022, even as inflation and inflation expectations accelerated. For example, on December 31, 2021, one

13. Owen J. Shoemaker, "Variance Estimates for Price Changes in the Consumer Price Index, January–December 2014," US Bureau of Labor Statistics, February 2015.
14. Treasury Borrowing Advisory Committee, "Minutes of the Meeting of the Treasury Borrowing Advisory Committee of the Securities Industry and Financial Markets Association," press release, August 4, 2009. The relevant quote here follows: "One member remarked that the issue was related to the choice of indexing to headline CPI rather than core CPI. The member said headline CPI was too volatile, too much of a play on commodities for the typical fixed-income investor and left the government effectively playing the commodity market rather than supporting long-term inflation hedging needs."
15. Quentin C. Chu, Deborah N. Pittman, and Linda Q. Yu, "When Do TIPS Prices Adjust to Inflation Information?," *Financial Analysts Journal* 67, no. 2 (March/April 2011): 59–73.

FIGURE 3. NET ANNUAL ISSUANCE OF TIPS



Source: Data were obtained from the US Treasury Monthly Statement of the Public Debt, January 2001 through January 2023.

Note: TIPS, Treasury Inflation-Protected Securities.

share of the iShares TIPS bond ETF had a price of $129.20. On June 30, 2022, the price of this ETF stood at $113.91, having paid dividends of $3.78, for a net return of –8.9 percent over a period of rising inflation and rising inflation expectations.

Figure 3 shows the evolution of the net issuance of TIPS by the Treasury, where net issuance is defined as sales less redemptions using the US Treasury Monthly Statement of the Public Debt. The Obama administration oversaw a substantial increase in TIPS issuance beginning in 2010. Two reports, one from the Government Accountability Office and one from the Treasury Borrowing Advisory Committee of the Securities Industry and Financial Markets Association, had advised that not only did the net issuance of TIPS need to increase substantially, but so did the schedule of auctions and the maturity window on TIPS.[16,17] The Treasury at that time concluded that the issuance of inflation-

16. Treasury Borrowing Advisory Committee, *TBAC Report to the Secretary of the Treasury* (Washington, DC: Treasury Borrowing Advisory Committee, 2009).
17. Susan Irving, *Treasury Inflation Protected Securities Should Play a Heightened Role in Addressing Debt Management Challenges,* GAO-09-932 (Washington, DC: Government Accountability Office, 2009).

FIGURE 4. GROSS MONTHLY INFLATION ADJUSTMENT FOR ALL OUTSTANDING TIPS

Source: Data were obtained from the US Treasury Monthly Statement of the Public Debt, January 2001 through February 2023.

Note: TIPS, Treasury Inflation-Protected Securities. The figure represents the total inflation adjustment to the principal on all outstanding debt, by month.

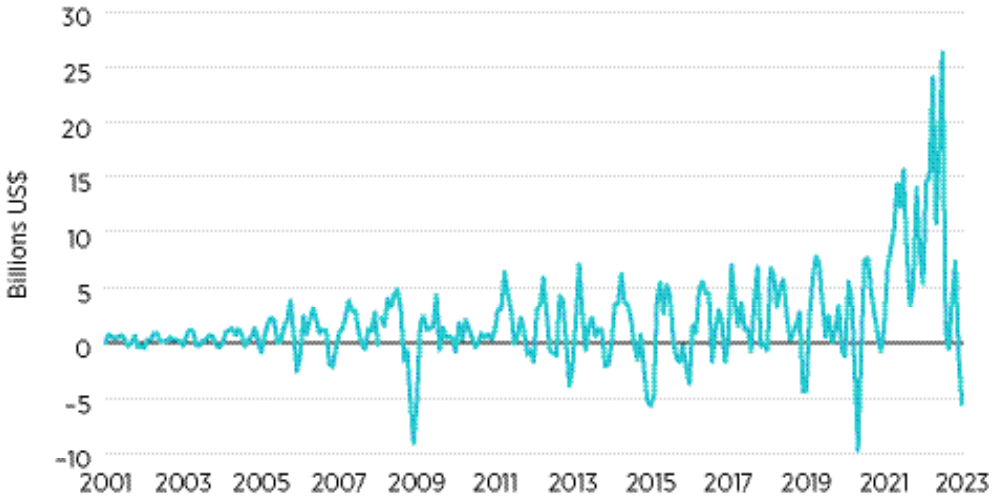
linked securities could provide it with the liquidity necessary to carry out fiscal plans because the perceived safety of the securities could assuage investor-related fears regarding inflation.[18] However, despite the fiscal expansion in the wake of the global financial crisis, fear of inflation gave way to fears of disinflation.[19] Demand for the bonds was not as robust as expected, leading to a drop in net issuance post-2016.

The amount of TIPS debt outstanding is not necessarily a function of net issuance because the inflation adjustments to the principal can affect the magnitude of the debt burden. As shown in figure 4, the gross monthly principal adjustment to all outstanding TIPS was $328.4 billion in February 2023. This

18. Treasury Borrowing Advisory Committee, "Minutes of the Meeting of the Treasury Borrowing Advisory Committee of the Securities Industry and Financial Markets Association," press release, July 30, 2008. In the minutes, "the presenting member then stated that TIPS have been a good value to investors, helping them to diversify inflation risks in fixed income portfolios and to express views on realized and expected inflation."

19. Treasury Borrowing Advisory Committee, *Report to the Secretary of the Treasury from the Treasury Borrowing Advisory Committee of the Securities Industry and Financial Markets Association*. Washington, DC: Treasury Borrowing Advisory Committee, February 2016.

FIGURE 5. NET MONTHLY INFLATION ADJUSTMENT FOR ALL OUTSTANDING TIPS



Source: Data were obtained from the US Treasury Monthly Statement of the Public Debt, January 2001 through February 2023.

Note: TIPS, Treasury Inflation-Protected Securities. The figure represents the net change in the total inflation adjustment to the principal on all outstanding debt (ignoring adjustments previously applied to maturing debt), by month.

fact invariably increases the outstanding inflation-linked debt as prices naturally fluctuate over time, but this is hardly the runaway effect one might think. In fact, when the effect of maturing securities is excluded from the analysis, the oscillatory nature of the CPI-U, the index upon which the TIPS principal is adjusted, becomes quite apparent. As shown in figure 5, this adjustment has not materially affected the amount of TIPS bonds outstanding in the long term, especially if one considers the many short periods of negative adjustment to the TIPS principal.

Series I Bonds

The Clinton administration set up the I bond program in 1998 with several unique characteristics for individual investors. Compared to TIPS, the I bond program offers less liquidity but greater tax benefits and less interest rate risk. The intention was to create two different products tailored to two interrelated but ultimately distinct consumers. I bonds would be for households and TIPS for banks.

Series I bonds were excluded from all state and local taxation and could have the entirety of their taxes paid at the maturity date rather than throughout

the life of the bond (31 C.F.R. § 359.B). The principal benefit is the reinvestment of dividends that otherwise would have been taxed. Investors can also avoid paying taxes entirely on the bond if the principal is used strategically because the Series I bond falls under the Education Savings Bonds program, which allows for exemption from taxes should the interest earned be spent on higher education during the same time (31 C.F.R. § 359.66). The Treasury imposed an initial cap of $30,000 per Social Security number on I bond purchases,[20] and this cap has kept those bonds smaller than other government securities programs. The tailoring of the rules of this program to retain consistency with other savings bonds is suggestive of how the Clinton administration designed the security, especially with regard to TIPS.

As mentioned earlier, the principal of TIPS scales with inflation, while its interest rate remains the same (31 C.F.R. § 356.30). Series I bonds differ significantly in that they have a fixed principal but a variable interest rate. In particular, Series I bond interest consists of two components: a fixed interest rate, which is constant from issue, and a variable inflation component based on CPI-U (31 C.F.R. § 359.13). The variable component is typically announced on November 1 and May 1 of each year (31 C.F.R. § 359.9.a), whereby all bonds subsequently sold after these dates until the next rate announcement have the same composite rate (31 C.F.R. § 359.10). When a new rate is announced, the new composite rate will not apply to each series immediately, but instead it will lag by the number of months the original sale was subsequent to the rate announcement (31 C.F.R. § 359.11). For example, bonds bought in October will have the same composite rate announced five months earlier in May, but they will not have the new November rate applied until April, being separated from November by five months.

Under the TIPS programs, the principal can be increased or decreased, depending on the prevailing inflationary conditions. Although the real, adjusted principal cannot be less than the nominal principal, the government must honor this condition only at redemption (31 C.F.R. § 356.30). The interest payments from TIPS can therefore be deflated, and gains to the principal during inflation can be, to some extent, eaten away by deflation, a particular concern for buyers who buy TIPS in the secondary market after inflation has already increased their principal. This approach stands in contrast to I bonds, which were given a floor interest rate of 0 percent in legislation surrounding the Uruguay Round

20. Offering and Governing Regulations for United States Savings Bonds, Series I; Issuing and Paying Agents; and Payment Under Special Endorsement." 63 Fed. Reg. 38036–38060 (July 14, 1998) (to be codified at 31 C.F.R. pts. 317, 321, 330, 359, 360).

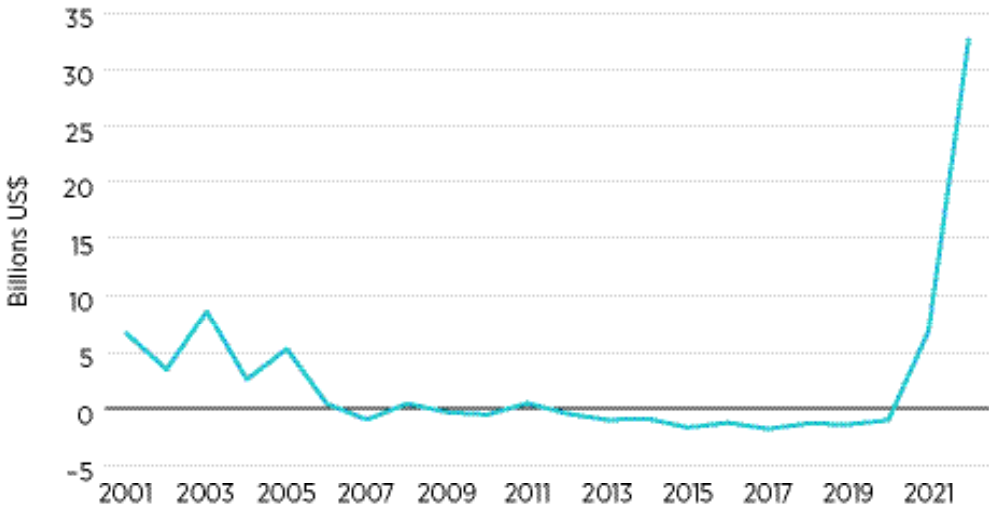
Agreements (31 C.F.R. § 359.12). Although interest payments might temporarily go to zero during periods of deflation (say, when the deflation exceeds the fixed rate on the bond, bringing the composite rate to 0 percent), the principal on I bonds never shrinks because of this 0 percent floor interest rate, thereby protecting investor gains. Therefore, even under the same fixed rate, TIPS and I bonds differ greatly in their response to deflation. For an investor looking to protect embedded gains from inflation against deflation, I bonds are a more attractive investment than TIPS, which can lose their nominal gains.

Unlike TIPS, the Treasury does not control the I bond supply directly, other than through the per-investor cap and the ability to make I bonds more or less attractive through the setting of the fixed-rate component of the I bond return. Once those parameters have been set, the net amount of I bonds issued is determined not by how much of the security the Treasury chooses to auction off net of maturing bonds, as they do with TIPS, but rather by investor purchases and redemptions. Unlike TIPS, if the Treasury wants to increase or decrease issuance, it cannot just issue more or fewer bonds. Rather, it must adjust the fixed rate for the next six months to influence investor demand. Investor demand subject to the cap and the Treasury-determined fixed rate thus essentially dictate the issuance and redemption of I bonds. Moreover, the horizons of the two instruments differ, with the government committing to an I bond maturity of 30 years unless investors want to redeem sooner. In fact, the first I bonds issued will not actually mature until 2028. The limited set of tools the Treasury has in the I bonds program, along with the slow pace of redemption on account of the maturity period, makes it difficult to fine-tune supply. During periods in which future fiscal burdens are perceived as small, this is not binding, but when investors are concerned about long-term inflation, the Treasury has to change program rules to affect issuance directly.

For example, during the middle of the 2008–2009 financial crisis, the Bush administration made one of the most substantive reforms to the program since it was first conceived: the purchase cap was reduced to $10,000 (72 Fed. Reg. 67853).[21] The primary reason cited was the need to divert some of this demand for I bonds to TIPS. The high level of uncertainty about inflation owing to the financial crisis might have driven up Series I demand significantly, especially if the manner of deflationary protection provided differed substantially from that of TIPS. It is possible, then, that the cap was introduced to prevent Series I from

21. An additional amount of up to $5,000 in paper I bonds can be accessed if a tax-filing household is due a tax refund and files IRS Form 8888.

FIGURE 6. NET ANNUAL ISSUANCE OF SERIES I BONDS



Sources: Data were obtained from the US Treasury Monthly Statement of the Public Debt, January 2001 through February 2023; Savings Bonds Securities Sold (US Treasury), 1998 through April 2010; and Interest Expense on the Public Debt Outstanding (US Treasury), May 2010 through February 2023.

becoming a great fiscal burden, even if the cap limited investment options for savers. As a result of this change, for much of the time since 2007, net issuance has actually been *negative*. Figure 6 shows this annual I bond issuance. Regardless of whether it was intended to shrink the scope of the program, the reduction in the cap effectively did that.

Historically, the Treasury has set the real rate on I bonds below the real rate on TIPS. For example, as of June 30, 2022, investors could buy a 30-year TIPS bond at a real rate of 0.96 percent, while the I bonds had a real yield fixed component of 0 percent. Arak and Rosenstein analyze the spread between I bonds and TIPS during a period (1999–2004) when the spreads were as large or larger than they are today. They estimate the value of the tax deferral and early-redemption option for investors and conclude that these features might be sufficiently valuable as to offset the lower real rate of I bonds.[22]

22. Marcelle Arak and Stuart Rosenstein, "I Bonds Versus TIPS: Should Individual Investors Prefer One to the Other?" *Financial Services Review* 15, no. 4 (Winter 2006): 265–80.

Other Inflation-Indexed Liabilities

The fact that a large portion of implicit government debt is already in effectively inflation-linked entitlement programs such as Social Security and Medicare could, in theory, play a similar disciplinary role for government borrowing as do inflation-linked bonds. These benefit programs promise streams of cash flows that are linked to inflation. In the case of Social Security, benefits are indexed to wage growth before an individual's retirement and indexed to inflation thereafter. In the case of Medicare, the rules are complex, but for a given promise of medical services, it is clear that such a promise increases in nominal dollars to the extent that increases in inflation affect the cost of medical services.

Inflationary fiscal or monetary policy would not reduce the promised cash flows associated with a purely inflation-linked benefit stream. Rising inflation would put increasing pressure on the unified federal budget, providing incentives for the federal government to increase taxes or reduce other spending to prevent further increases in debt. Two key factors limit this discipline, however. First, Congress can make changes to these programs without deleterious effects on its borrowing costs, so program costs are not necessarily expected to increase fully with inflation in the future. Second, Social Security and Medicare can be viewed as only partially inflation protected, given the rules of these programs. The unindexed thresholds in the US personal income tax code for Social Security benefits subject an increasing share of Social Security benefits to taxation, and Medicare premiums often rise faster than Social Security's cost of living adjustment.[23]

INFLATION EXPECTATIONS AND MARKET PRICES

One advantage of a market for inflation-indexed debt is that it should provide an opportunity for officials and the public to read a signal of market expectations of future inflation from market prices. The difference between a nominal yield and a real yield of the same tenor is often described as a "break-even rate." Rearranging equation (1) clarifies that a break-even rate reflects not only the market-implied rate of expected inflation but also a compensation for the risk that inflation will deviate from expectations as of the time of issue:

Expected Inflation = (Nominal Yield – Real Yield) – Inflation Risk Premium (2)

23. Alicia Munnell and Patrick Hubbard, "The Impact of Inflation on Social Security Benefits," Brief 12-14, Center for Retirement Research at Boston College, Chestnut Hill, MA, August 2021.

If one considers only this factor, the break-even rate would be an upper bound on a measure of market-implied expected inflation because the yield on inflation-linked debt reflects the valuable insurance provided by real debt against inflation rising above expectations.

In US Treasury markets, the break-even rate for a given tenor is defined more explicitly as the difference between Treasury and TIPS yields:

$$\text{US Break-Even Rate} \equiv \text{Treasury Yield} - \text{TIPS Yield} \tag{3}$$

In interpreting the US break-even rate relative to market-implied inflation expectations, one must consider an additional factor beyond the fact that the nominal bonds include an inflation risk premium. In addition, the exceptional liquidity of nominal Treasury debt pushes down its yields, introducing a countervailing downward bias in the US break-even rate as a measure of expected inflation; that is, liquidity and convenience of nominal US Treasury bonds likely pushes down nominal yields relative to TIPS and any other securities that do not share the same money-like quality as nominal bonds.[24] Whether the Treasury benefits from issuing TIPS or not can be seen as a question of whether the losses to the Treasury of issuing less liquid securities in the form of TIPS are outweighed by the gains to the Treasury of not having to compensate investors for the inflation risk premium.[25,26]

Combining equations (2) and (3)—and recognizing that the observed nominal yield includes downward liquidity pressure—generates the following expressions for expected inflation, or equivalently for the relationship between the US break-even rate and expected inflation:

$$\text{Expected Inflation} = \text{US Break-Even Rate} + \text{Liquidity Adjustment} - \text{Inflation Risk Premium} \tag{4a}$$

$$\text{US Break-Even Rate} = \text{Expected Inflation} + \text{Inflation Risk Premium} - \text{Liquidity Adjustment} \tag{4b}$$

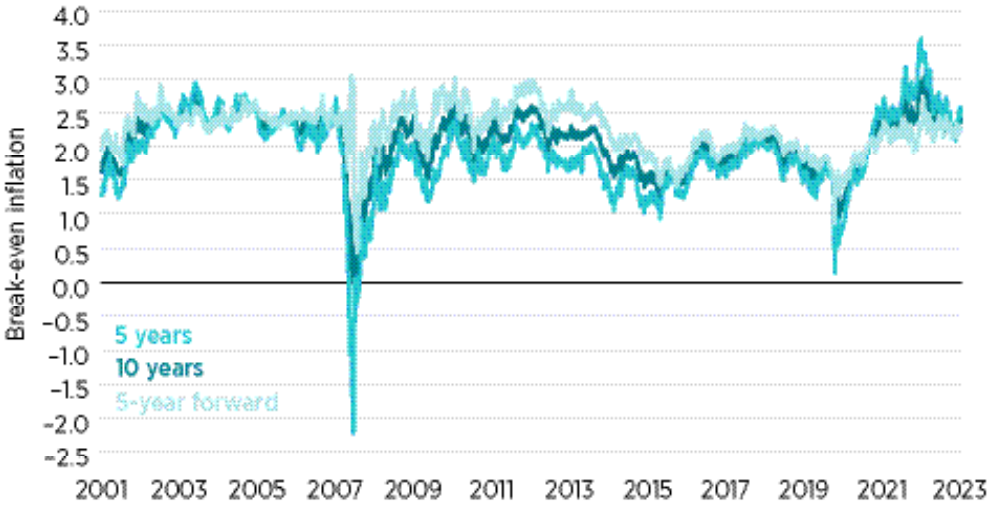
In markets other than the United States, the liquidity adjustment is expected to be somewhat smaller because non-US nominal bonds generally do not have

24. Arvind Krishnamurthy and Annette Vissing-Jorgensen, "The Aggregate Demand for Treasury Debt," *Journal of Political Economy* 120, no. 2 (April 2012): 233–67.

25. Jens Christensen and James Gillan, "Has the Treasury Benefited from Issuing TIPS?" *FRBSF Economic Letter* 2011–12, no. 12 (April 2011). Other papers have studied the properties of these risk and liquidity premia over time.

26. Carolin E. Pflueger and Luis Viceira, "Inflation-Indexed Bonds and the Expectations Hypothesis," *Annual Review of Financial Economics* 3, no. 1 (December 2011): 139–58. For example, Pflueger and Viceira empirically estimate risk and liquidity premia in both nominal and real bonds, finding significant variation.

FIGURE 7. BREAK-EVEN INFLATION RATES FROM THE UNITED STATES



Source: Break-even inflation data were obtained from Gürkaynak, Sack, and Wright (2010).

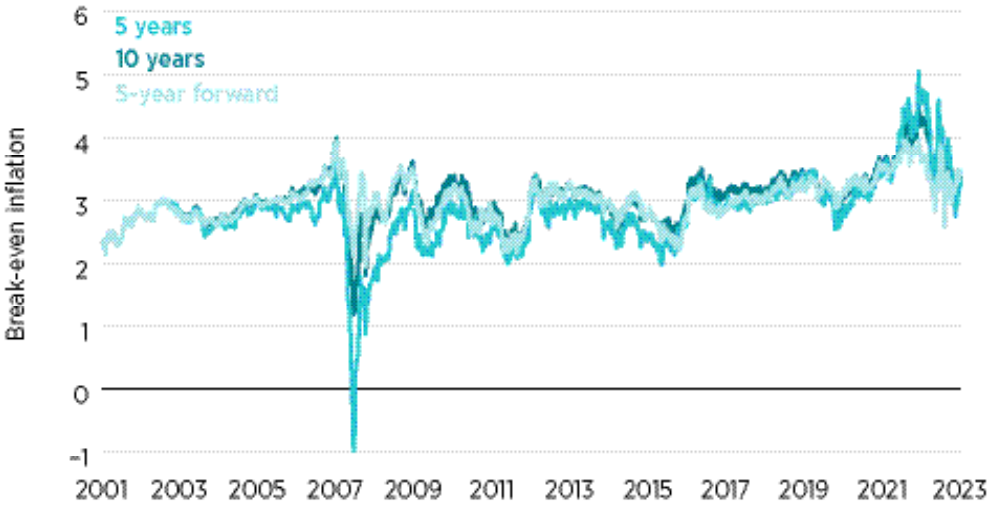
Note: The authors calculate a zero-coupon yield for each individual interest payment due between now and maturity for all outstanding nominal and inflation-indexed securities, and then they use that set of interest payments to calculate a yield for a given period based on the Nelson-Siegel-Svensson functional form. The break-even inflation rates are merely the difference between nominal and real yields for a given period. All series are through February 28, 2023.

the same convenience yield as US Treasuries, given the dollar's critical role as a reserve currency. UK gilts may also have somewhat lower yields, reflecting their important role in financial markets.[27] An additional factor affecting UK markets is that UK inflation-linked gilts (linkers) pay a return that is linked to the Retail Price Index (RPI), an index that is estimated to exceed overall consumer price inflation by as much as one percentage point.

Figure 7 shows the US break-even rate as defined by the Treasury bond markets on the left side of equation (4b). The figure shows the 5-year, 5-year forward 5-year rates, and 10-year rates. The break-even inflation rate on a 5-year horizon spiked in 2022 to above 3 percent, a level not seen previously during the two decades for which these data are available. The 5-year forward 5-year rates have increased coming out of the COVID-19 crisis period but remained moderate by historical standards. Furthermore, the break-even inflation rates prevailing in

27. Zhengyang Jiang, Arvind Krishnamurthy, and Hanno Lustig, "Foreign Safe Asset Demand and the Dollar Exchange Rate," *Journal of Finance* 76, no. 3 (June 2021): 1049–89.

FIGURE 8. BREAK-EVEN INFLATION RATES FROM THE UNITED KINGDOM



Source: Break-even inflation figures were obtained from the Bank of England. Anderson and Sleath, authors of the methodology behind the yields used to calculate break-even inflation, built upon the work of Daniel Waggoner at the Federal Reserve, which uses a spline method combined with a roughness penalty that increases with time to generate a likely yield curve. See Nicola Anderson and John Sleath, "New Estimates of the UK Real and Nominal Yield Curves" (Bank of England Working Paper no. 126, Bank of England, London, 28 March 2001).

Note: All series are through February 28, 2023.

2022 were substantially below the trailing 12-month inflation, which reached 9.1 percent in the year ending June 2022.

Figure 8 shows break-even inflation rates implied by the UK inflation-linked gilt market versus nominal UK gilts. These break-even rates have been somewhat less variable over the past two decades than the US break-even rates, but also at somewhat higher levels, perhaps reflecting the fact that the market inflation expectations reflected in the index-linked gilts are RPI rates as opposed to CPI rates.

Various research papers have estimated a range of values for the inflation risk premium, although the estimates are highly dependent on model assumptions. In Treasury bond data from 1965 to 2005, Buraschi and Jiltsov estimate an inflation risk premium that averages 70 basis points.[28] The Federal Reserve Bank of Cleveland estimates the inflation risk premium using a model-based approach,

28. Andrea Buraschi and Alexei Jiltsov, "Inflation Risk Premia and the Expectations Hypothesis," *Journal of Financial Economics* 75, no. 2 (February 2005): 429–90.

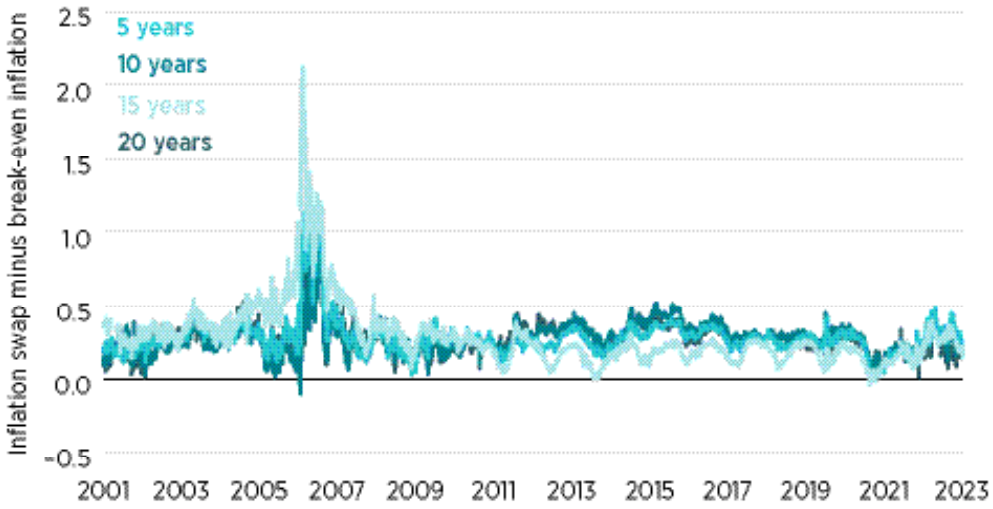
and its value has largely stayed within a range of 30–50 basis points since the start of the series in the mid-1980s.[29]

Measures of the liquidity effect on nominal Treasury bonds can be directly estimated by comparing break-even inflation rates based on the Treasury's TIPS spread with inflation swaps. In an inflation swap contract, counterparties exchange a stream of nominal cash flows for a stream of inflation-linked cash flows. Fleckenstein, Longstaff, and Lustig calculated these spreads on a cashflow-by-cashflow basis in US data on individual bonds through 2009; they documented substantial "mispricing" between the Treasury's TIPS break-even rate and the inflation swap rate.[30] Such price differences may reflect limits to the depth of capital available to arbitrage away price differences.[31] but may also reflect fundamentally different liquidity properties of Treasuries versus TIPS. An assessment by Sack and Elsasser argues that "[b]ecause of the low valuation of [TIPS] relative to nominal securities, inflation-indexed debt has not yet lived up to its purpose of reducing financing costs for the Treasury."[32] D'Amico, Kim, and Wei use no-arbitrage term structure models to find that TIPS yields exceeded true underlying real yields by as much as 300 basis points during the financial crisis period of 2007–2008.[33]

Figure 9 offers a similar analysis at an aggregate level, comparing US zero-coupon inflation swap rates (for 5-year, 10-year, 15-year, and 20-year tenors) with the break-even rate of inflation at the same horizon. This is not a perfect arbitrage comparison given that the swaps are zero-coupon and the break-even rate is calculated for Treasury securities of a given maturity using Federal Reserve methodology.[34] The differences plotted in the figure follow a similar pattern to those found by Fleckenstein, Longstaff, and Lustig through the end of their sam-

29. Joseph Haubrich, George Pennacchi, and Peter Ritchken, "Inflation Expectations, Real Rates, and Risk Premia: Evidence from Inflation Swaps," *Review of Financial Studies* 25, no. 5 (May 2012): 1588–629. For further details, see the St. Louis Fed's FRED series, "Inflation Risk Premium" (Series ID: TENEXPCHAINFRISPRE), https://fred.stlouisfed.org/series/TENEXPCHAINFRISPRE.
30. Fleckenstein, Longstaff, and Lustig, "The TIPS-Treasury Bond Puzzle."
31. Andrei Shleifer and Robert Vishny, "The Limits of Arbitrage," *Journal of Finance* 52, no. 1 (March 1997): 35-55."
32. Brian Sack and Robert Elsasser, "Treasury Inflation-Indexed Debt: A Review of the U.S. Experience," *Federal Reserve Bank of New York Economic Policy Review* 10, no. 1 (May 2004): 48.
33. Stefania D'Amico, Don H. Kim, and Min Wei, "Tips from TIPS: The Informational Content of Treasury Inflation-Protected Security Prices," *Journal of Financial and Quantitative Analysis* 53, no. 1 (February 2018): 395–436.
34. Refet Gürkaynak, Brian Sack, and Jonathan Wright, "The TIPS Yield Curve and Inflation Compensation," *American Economic Journal: Macroeconomics* 2, no. 1 (January 2010): 70–92. Gürkaynak, Sack, and Wright calculate a zero-coupon yield for each individual interest payment due between now and maturity for all outstanding nominal and inflation-indexed securities and then use that set of interest payments to calculate a yield for a given period based on the Nelson-Siegel-Svensson functional form. The break-even inflation rates are merely the difference between nominal and real yields for a given period.

FIGURE 9. ZERO-COUPON INFLATION SWAP MINUS BREAK-EVEN INFLATION IN THE UNITED STATES



Source: Inflation swaps were obtained from Bloomberg [USSWIT05, 10, 15, 20], and break-even inflation are the series shown in figure 7 as calculated from Federal Reserve data.

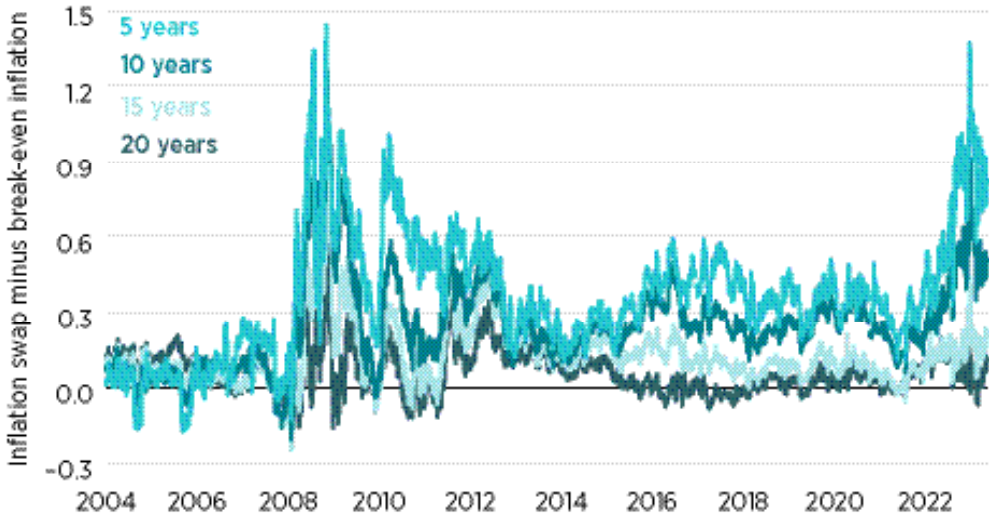
Note: All series are through February 28, 2023.

ple period in 2009.35 After that, coupon rates on Treasury securities were very low, implying a close match between maturity and duration, so that break-even inflation is more directly comparable to the zero-coupon inflation swap. Since the market dislocations of 2008–2009, the deviations between the actual and synthetic break-even rates have generally ranged between 0 and 50 basis points, with the longer maturities generally showing larger differences. The most recent observations in 2022 are close to the highs for the post-2009 series, indicating that break-even inflation implied by the TIPS and Treasury markets seems low compared to levels of expected inflation implied by inflation swaps. Ultimately, therefore, the observed differences between the US break-even rate and inflation implied by the swap market do not seem so large as to outweigh the typical estimates from the literature of the inflation risk premium.

Figure 10 shows the results of a similar analysis carried out on UK data. Because the UK zero-coupon inflation swap is also defined relative to the RPI, the use of RPI rather than CPI should not materially affect the liquidity analysis.

35. Fleckenstein, Longstaff, and Lustig, "The TIPS-Treasury Bond Puzzle."

FIGURE 10. ZERO-COUPON INFLATION SWAP MINUS BREAK-EVEN INFLATION IN THE UNITED KINGDOM



Source: Inflation swaps were obtained from Bloomberg [BPSWIT05, 10, 15, 20], and break-even inflation are the series shown in figure 8 as obtained from the Bank of England.

Note: All series are through February 28, 2023.

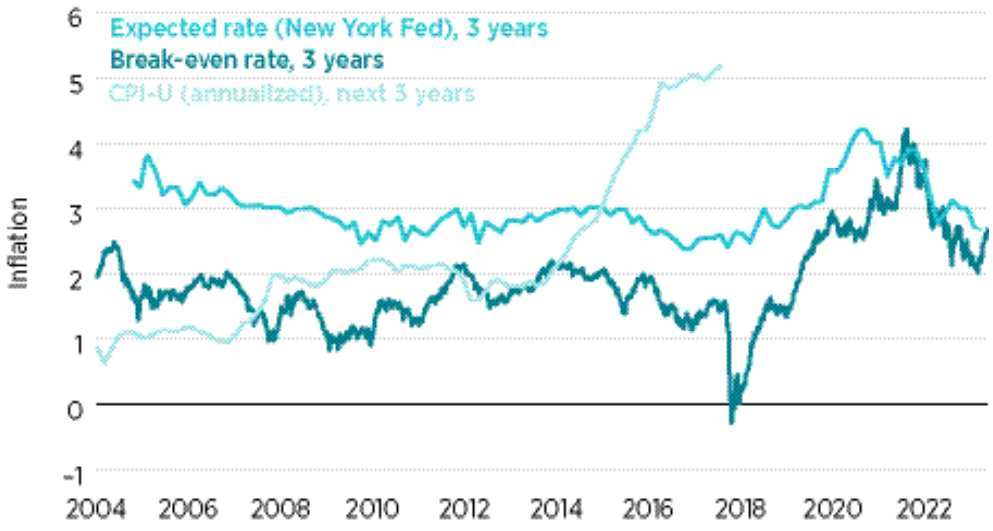
Compared with the US series shown in figure 9, several key differences emerge. First, the dislocation in the financial crisis was not as large but extended for a longer period of time. Second, while the pricing differences were also roughly in the range of 0 to 50 basis points for the 2011–2021 decade, they generally have hovered around zero for the longer (15-year and 20-year) tenors, suggesting there is little or no excess liquidity in gilts of these longer-term maturities. Third, during the 2022 inflationary episode, the difference between the UK break-even rate and the zero-coupon inflation swaps for the 5-year tenor rose to its highest level since the financial crisis, reaching almost 150 basis points, and the 10-year tenor rose to its highest level since 2013, reaching nearly 100 basis points.

Figure 11 demonstrates the relationship between break-even inflation rates and inflation expectations, particularly those of consumers, in the United States.[36]

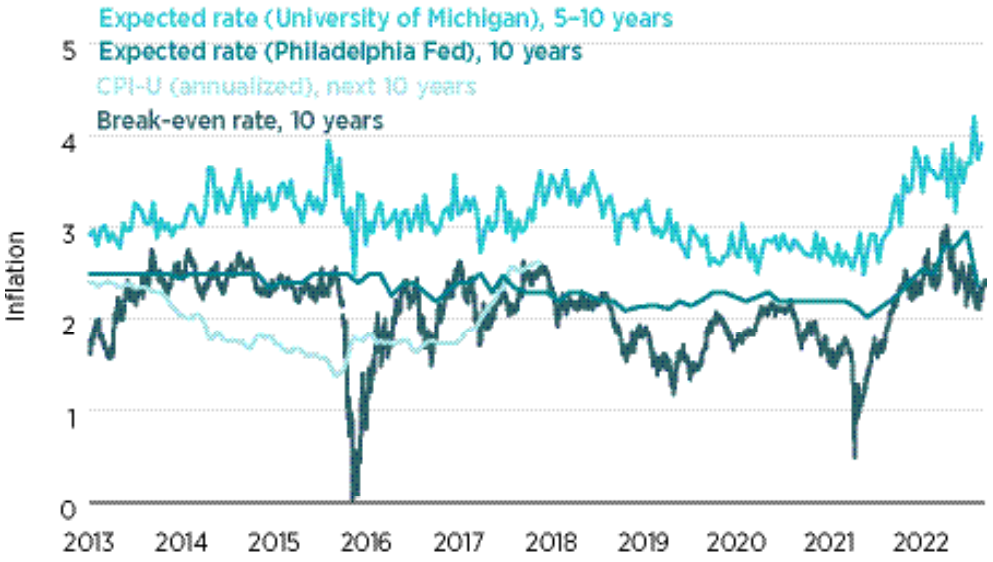
36. Consumer expectations for the 10- and 3-year horizons are represented by both the University of Michigan's Survey of Consumer Expectations and the New York Federal Reserve's Survey of Consumer Expectations, respectively. These surveys gauge the expectations of the general public about the inflation rate over certain time frames. In both surveys, each response is weighted via demographic characteristics and confidence of prediction.

FIGURE 11. EXPECTED INFLATION, BREAK-EVEN INFLATION, AND ACTUAL INFLATION IN THE UNITED STATES

a. Short Horizon



b. Long Horizon



Sources: CPI-U data are from the Federal Reserve; break-even data are the series shown in figure 7; short-horizon consumer expectations are from the New York Federal Reserve's Survey of Consumer Expectations; long-horizon consumer expectations are from the University of Michigan's Survey of Consumer Expectations; long-horizon professional expectations are from the Philadelphia Federal Reserve's Survey of Professional Forecasters.

Without the liquidity adjustment and inflation risk premium, one might expect these to be roughly equal if one assumes that the inflation expectations of consumers reflect the inflation expectations of the marginal investor. In reality, however, expectations consistently outpace break-even inflation rates, suggesting that the liquidity adjustment is greater than the inflation risk premium. This behavior has changed recently at the short end, however, where the three-year break-even inflation has increased by over 300 basis points in the past 18 months, but inflation expectations have increased by only about half that.

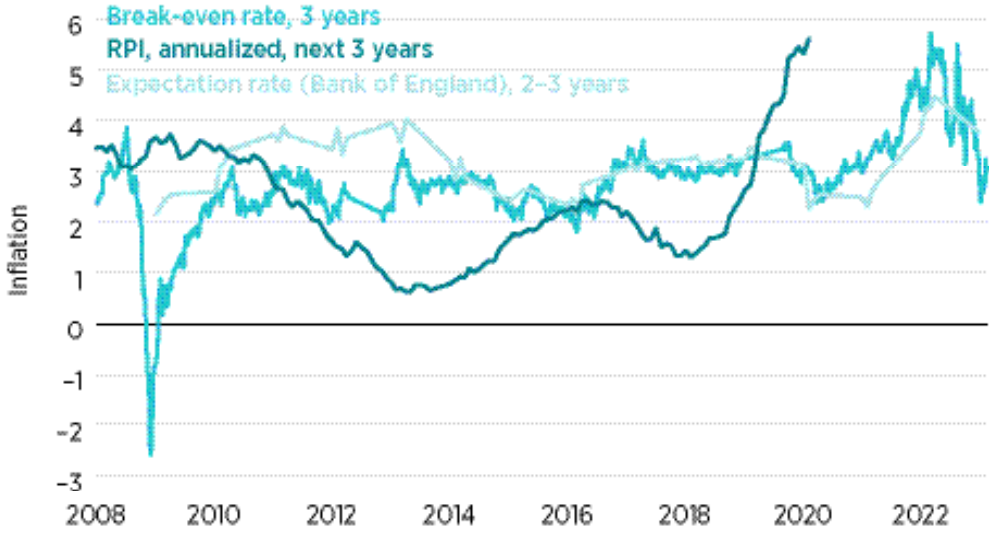
The implication, especially lacking any movement on the short end of the illiquidity measures suggested by panel a of figure 11, is that the inflation risk premium on a three-year horizon has increased substantially in the past two years. Panel b shows that whether this divergence has also occurred at longer horizons depends on which forecasts one uses to measure expected inflation. If the long-term consumer inflation forecasts published by the University of Michigan are used, the expected rate and break-even rates seem to move in tandem, with relatively constant spreads between them. The story changes quite considerably, however, if professional forecasts more closely mirror the expectations of the marginal investor.[37] The break-even rate more closely tracks professional forecasts of the Philadelphia Fed Survey, with the inflation risk premium shrinking or the liquidity adjustment increasing to drive a wedge between expected inflation and the break-even rate only during flights to safety or particularly near-deflationary periods, like the mid-2010s. Otherwise, the relative parity between break-even inflation rates and inflation expectations demonstrates that the inflation risk premium and liquidity adjustment are close to equal, which, as shown in equation (4a), leads to the break-even rate being very close to inflation expectations. Thus, the recent return to a market where break-even inflation and expectations more closely mirror one another is an expression of an increase in the inflation risk premium over the past year to a magnitude that more closely matches the liquidity premium.

Figure 12 shows that consumer inflation expectations in the United Kingdom, as measured by the Bank of England–Ipsos Inflation Attitudes Survey, are closely linked with the long-term behavior of break-even inflation. As shown in figure 10, the liquidity adjustment on inflation-indexed gilts at short-to-medium maturities is quite substantial, having been that way since the end of the global financial crisis but increasing dramatically in the past year. Under such circum-

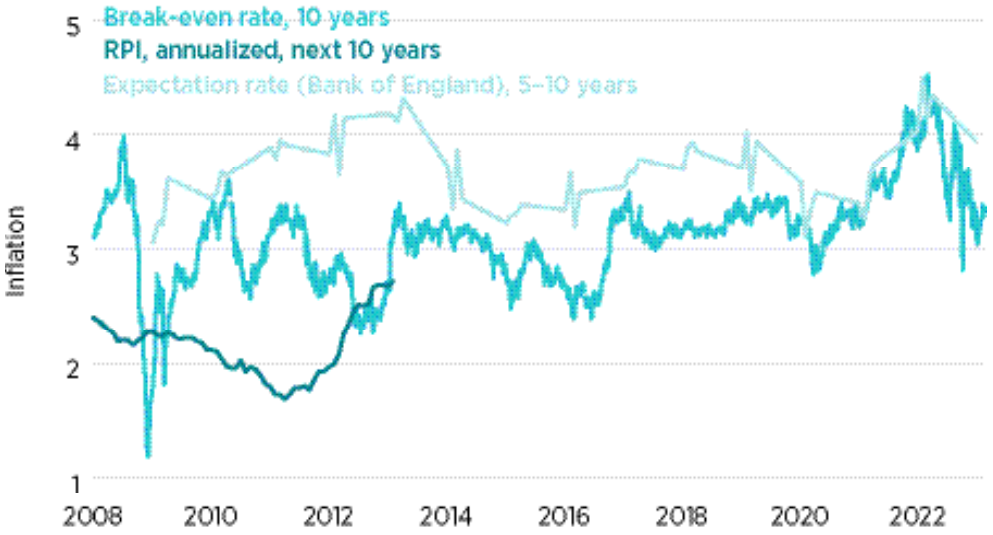
37. Inflation expectations of economic professionals, obtained from the Philadelphia Fed's Survey of Professional Forecasters, estimate the inflation for the next year and are based on the geometric mean of the forecaster's prediction for each of the coming four economic quarters.

FIGURE 12. EXPECTED INFLATION VERSUS BREAK-EVEN INFLATION IN THE UNITED KINGDOM

a. Short Horizon



b. Long Horizon



Sources: CPI-U data are from the Federal Reserve; break-even data are the series shown in figure 7; short-horizon consumer expectations are from the New York Federal Reserve's Survey of Consumer Expectations; long-horizon consumer expectations are from the University of Michigan's Survey of Consumer Expectations; long-horizon professional expectations are from the Philadelphia Federal Reserve's Survey of Professional Forecasters.

stances, other things being equal, one might expect the gap between the break-even inflation rates and inflation expectations to widen, but, in practice, it has shrunk. Taken together, the evidence suggests that both the liquidity premium and the inflation risk premium have increased substantially, with the inflation risk premium having increased even more.

Overall, if US consumer expectations are reflective of the expectations of the marginal investor, then the liquidity adjustment has often been greater than the implied inflation risk premium in nearly all time periods and tenors considered before the current inflationary wave. During the current inflationary wave, the gap between expected inflation and the break-even rate collapsed on the shorter (3-year) tenor, suggesting an increase in the inflation risk premium to the level of the liquidity penalty. If professional forecasters reveal the survey expectations of the marginal investor, then there has been a similar convergence at the long (10-year) end of the curve. In the United Kingdom, expected inflation and break-even inflation have more closely tracked each other at the shorter maturities and have shown a similar convergence as seen in the United States at the longer horizons, where the liquidity penalty has generally remained stable. With the lack of sufficient movement in the liquidity adjustment to offset the growth in break-even inflation, equations (4a) and (4b) imply that the inflation risk premium must have increased.

CONCLUSION: EXPANDING MARKETS FOR INFLATION-INDEXED DEBT

In this section, I conclude with a short assessment of two options for expanding markets for inflation-indexed government debt. The main advantages of expanding government issuance of inflation-indexed debt would be more accurate market-based inflation signals for the Fed and market participants, the avoidance of the Treasury having to pay an inflation risk premium, more access by market participants to inflation protection, and more discipline by the federal government. The disadvantages are that the Treasury must pay any liquidity spread over regular government bonds or find a way to eliminate that spread, as well as the fact that, in inflationary episodes, interest rates automatically would increase—placing a greater burden on the budget. Given the disciplinary role that inflation-indexed debt serves, the latter may be more of a feature than a bug.

The evidence presented in this paper suggests that, after what appears to be a recent increase in the inflation risk premium, the observed differences between the break-even rates and inflation implied by the swap market do not

seem so large as to outweigh the typical estimates from the literature of the inflation risk premium. Thus, even without changes that might address liquidity in the inflation-indexed market, there is a case to be made for expanding the issuance of TIPS. That case would be even stronger if the TIPS market were expanded in conjunction with actions that would increase its liquidity. Indeed, if one of the key disadvantages to the main form of inflation-indexed debt as it is currently structured is the liquidity cost, it would be valuable to consider whether this liquidity cost could be addressed directly rather than assumed to be unalterable.

In fact, there are two important aspects of the structure of TIPS that dramatically reduce their liquidity. First, an already small market is spread over many maturities, and—to complicate matters—the deflation protection in TIPS means that the amount of inflation that has occurred since the issuance of a given inflation-protected TIPS bond affects the amount of deflation protection that the bond has should price changes turn negative.[38] A TIPS bond that has only a small historically embedded inflation increase has more deflation protection than one that does not. Second, as previously explained, TIPS have a complex tax treatment. The adjustments that occur to the principal trigger an immediate tax liability, even though the investor has not actually realized a capital gain.

Fortunately, both of these problems could be addressed. The tax treatment of TIPS could be changed so that principal increases triggered by the inflation indexation are not taxed upon accrual. Deflation protection could also be defined in a way that did not vary with the price of the bond relative to its original face value, either by eliminating the deflation protection or by allowing the adjusted face value to fall below its original value. In addition, liquidity would improve if substantially more bonds were issued. The liquidity effect is unlikely to go to zero, but it could be substantially reduced.[39]

Another way of issuing more inflation-linked debt would be to liberalize the market for I bonds. A straightforward approach to this option would lift the $10,000 per Social Security number cap, as suggested by Rauh and Warsh.[40] The Protecting Americans' Savings Act of 2022 introduced in the 117th Congress on

38. John H. Cochrane, "A New Structure for U.S. Federal Debt," in *The $13 Trillion Question: How America Manages Its Debt*, ed. David Wessel (Washington, DC: Brookings Institution Press, November 2015), 91–146.
39. Cochrane, "A New Structure." In addition, Cochrane points out that if all bonds were perpetual, the debt would be considerably more liquid because the bonds would be identical rather than divided into hundreds of distinct securities.
40. Joshua Rauh and Kevin Warsh, "The Inflation Mess and a Financial Refuge," *Wall Street Journal*, February 21, 2022.

March 9, 2022, and referred to the Committee on Financial Services and the Committee on Ways and Means, would direct "the Department of the Treasury to report on the effects of inflation on the value of individuals' savings and the feasibility of raising the current individual limit on inflation-protected Treasury Series I Savings bonds."[41] The I bond market could also be made more liquid by allowing for earlier, penalty-free withdrawals. These measures would bring substantial additional savings into the I bond market because owners of I bonds often report wanting more I bonds than they can access.

A further obstacle to I bond purchases relates to the antiquated nature of the Treasury Direct website, with which users often report bad experiences. According to Fuller and Zweig in the *Wall Street Journal*, some customers are not instantly approved for Treasury Direct accounts, especially if their information does not match the Treasury's verification information on file.[42] In such a case, the signature of the taxpayer must be certified on IRS Form 5444, a process that involves finding a bank branch that provides this service.[43] Modernizing the Treasury Direct website and verification process, improving liquidity, and lifting the cap would all be popular measures among savers.

Two main objections might be raised against such measures. The first is the claim that, even with improvements in the market, the government will still lose more in the liquidity reduction it suffers when moving from nominal to real debt than it will gain by not having to pay the inflation risk premium to investors. The analysis in this paper has shown that the magnitude of this effect is not as large relative to the inflation risk premium as might be assumed, particularly at times when investors are worried about inflation. Except in periods of serious market dislocation such as financial crises, break-even inflation rates do in fact proxy inflation expectations in the professional forecaster market and have come much closer recently in the consumer market—and this before any attempt to reform and improve the liquidity of the inflation-linked market.

The second objection is that inflation-linked bonds generally are costly to the government in periods of inflation because interest payments would automatically rise with inflation. But this is an ex post statement. From the perspective of optimal debt policy, what the government should care about is the ex ante

41. "Summary: H.R. 7005—117th Congress (2021–2022), https://www.congress.gov/bill/117th-congress/house-bill/7005?s=1&r=50.
42. Andrea Fuller and Jason Zweig, "If Inflation Hasn't Made You Crazy, Try Buying an I Bond," *Wall Street Journal*, June 29, 2022.
43. Fuller and Zweig, "If Inflation Hasn't." According to this article, the fact that some "investors give up vacation and drive hours to navigate bureaucracy" indicates that they place a high value on access to this inflation-protected savings vehicle.

tradeoff between liquidity premium and inflation risk premium. Furthermore, the rise in interest payments in inflationary episodes when there is inflation-linked debt provides an incentive for fiscal policymakers to address inflation. Given the acknowledged role that fiscal policy plays in inflation, the recognition by policymakers ex ante that inflation would have a more direct effect on debt costs would provide a strong disciplinary incentive to avoid and combat inflation.

Inflation has long been referred to as a stealth tax on savings. If the government actually wishes to limit this stealth tax, it could easily do so by raising the share of inflation-indexed debt and making such debt more liquid.

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