

Inflation and Asset Returns*

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Abstract

The past half-century has seen major shifts in inflation expectations, how inflation comoves with the business cycle, and how stocks comove with Treasury bonds. Against this backdrop, we review the economic channels and empirical evidence on how inflation is priced in financial markets. Not all inflation episodes are created equal. We therefore discuss asset pricing implications of “good” and “bad” inflation from the vantage point of macroeconomic shocks that drive the economy. We conclude by providing an outlook for future research and the implications for the newly rising inflation.

Keywords: inflation, risk premia, bond return predictability, stagflation, monetary policy

JEL Classifications: E43, E52, E58

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1 Introduction

The recent surge in inflation has spurred renewed questions about what drives inflation, why it is considered so costly by households, investors, and policymakers alike, and what high inflation means for governments' and firms' ability to fund themselves and households' ability to protect their retirement portfolios. Few would dispute that long-lasting episodes of high inflation pose a major risk for investors in nominal bonds, eroding their ability to consume out of fixed dollar payoffs. For investors in financial claims such as stocks that derive their value from real assets, intuition might instead suggest that inflation poses no tangible threat. Unfortunately, this intuition has badly failed over a significant part of the past century. Understanding the economic mechanism linking inflation and asset prices and how it manifests itself in the data is therefore crucial. For investors, this link matters for assessing the risks they bear. For policymakers, it provides a window into how financial markets perceive fundamental shocks, informing the appropriate policy response.

Not surprisingly, the recent reemergence of inflation is awakening the memories of the past. Figure 1 displays major macro-finance trends since the early 1950s, superimposing the price-to-earnings ratio for the S&P 500 index as a measure of stock valuation, the 10-year nominal Treasury yield, which is inversely related to bond prices, and the annualized 10-year consumer price inflation rate. Panel A presents the data in levels, Panel B in changes. In Panel A, the high and persistent inflation of the 1970s and 1980s was accompanied not only by high nominal yields and, thus, low prices of nominal bonds, but also by depressed stock market valuations, otherwise not seen since the time of the Great Depression of the 1930s.¹ The following decades erased part of that Great Inflation experience, being hallmarked by gradually declining inflation expectations, low nominal yields, and historically high stock market valuations. As these generational trends unfolded, the properties of how stocks and yields comove with each other at higher frequencies changed as well. Panel B shows that the correlation between stock returns and yield changes switched sign from negative to positive around the turn of the 21st century. With nominal bonds hedging downturns in the stock market in more recent decades, these shifts have had profound implications for long-term investors' ability to diversify risks.

What economic forces underlie these major shifts? How can they be linked to investors' expectations of macroeconomic fundamentals and to the risk compensation that investors

¹A long literature going back to the 1980s has found that stocks have poor hedging properties against inflation, i.e., returns not only do not rise but may in fact fall when expected or unexpected inflation is high (French et al. (1983), Fama and Schwert (1977)). Boudoukh and Richardson (1993) argue that over multi-year horizons nominal stock returns do increase with inflation, though the relationship is less than one-for-one and real stock returns are still negatively correlated with long-term inflation.

require for bearing fundamental risks? Fortunately, macro-finance research has made significant forays into understanding these questions. In this review, we combine different strands of research to take stock of the answers that we currently have. The guiding theme of our discussion is that inflation comes in different flavors. We highlight the features of “good” and “bad” types, depending on why and when inflation occurs over the business cycle, whether it persists, and what asset pricing consequences it has.

2 Economic channels linking inflation and asset prices

To introduce the notion of the “good” and “bad” inflation varieties, we start by reviewing the basic theory linking inflation and asset prices. We assume that all assets are priced by a representative investor, i.e., there exists a *stochastic discount factor* (SDF), M_{t+1} , such that for any asset with a real time- $(t + 1)$ payoff X_{t+1} the time- t price of the asset is given by $P_t = E_t [M_{t+1}X_{t+1}]$.

Inflation is particularly relevant for assets whose payoffs are fixed in dollars, such as nominal Treasury bonds. Let i_t and $i_t^{(2)}$ denote the interest rates on one- and two-period default-free nominal bonds, i.e. a bond that promises to pay one dollar one or two periods in the future. The corresponding bond prices are then given by $\exp(-i_t)$ and $\exp(-2i_t^{(2)})$. Similarly, let r denote the real risk-free rate, or the interest rate on a default free bond that promises to pay one unit of real consumption next period. The real risk-free rate is assumed to be constant for simplicity. We use π_t to denote log inflation from time $t - 1$ to time t , and use lower-case letters to denote logs throughout. Using the notation $\pi_t^e \equiv E_t \pi_{t+1}$ and assuming that inflation and the SDF are jointly log-normal, the one- and two-period nominal interest rates can be written as

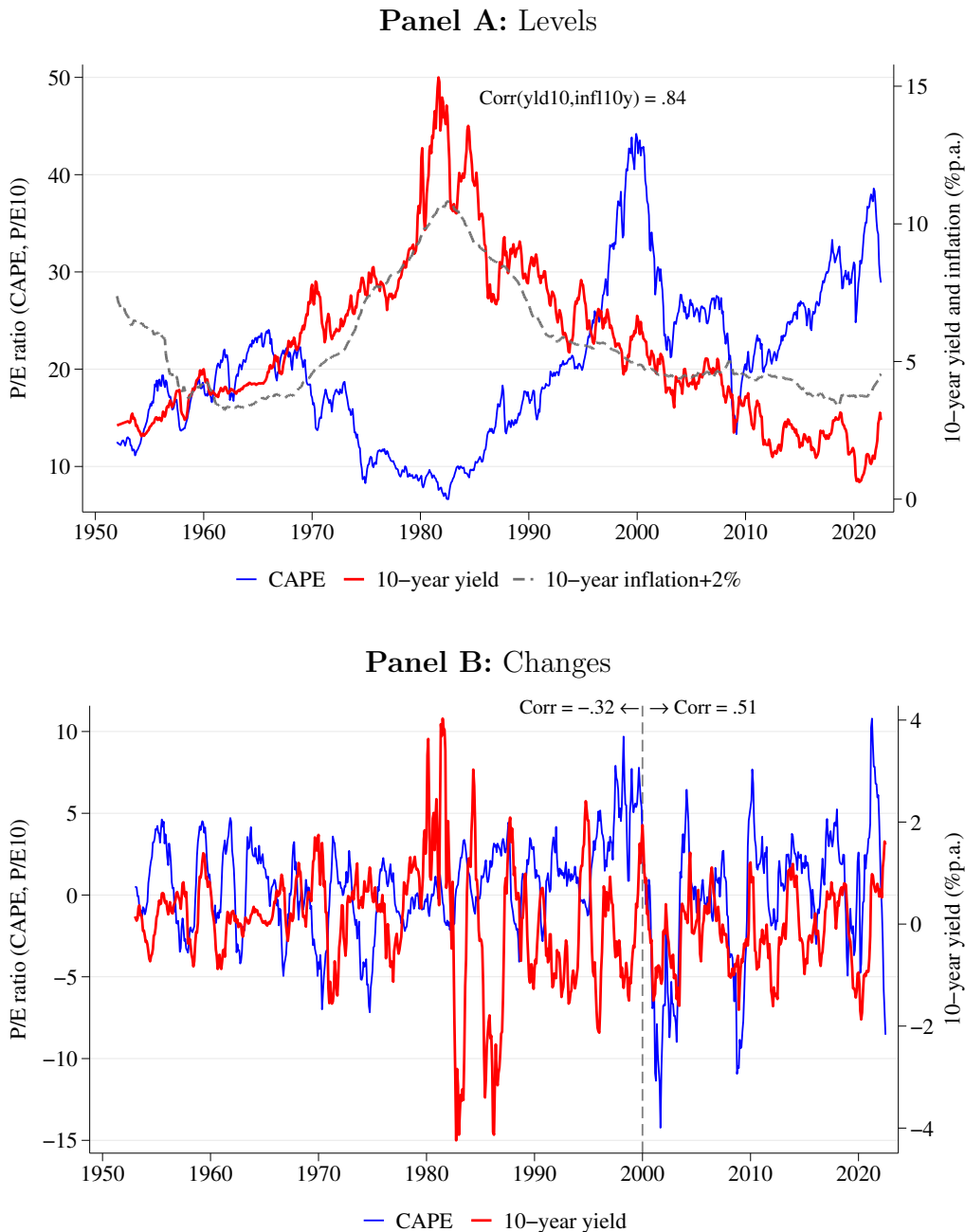
$$i_t = \underbrace{r + E_t \pi_{t+1}}_{\text{Fisher Equation}} + \underbrace{Cov_t(m_{t+1}, \pi_{t+1})}_{\text{Risk Premium}} - \frac{1}{2} \sigma_\pi^2, \quad (1)$$

$$i_t^{(2)} - \underbrace{\frac{i_t + E_t i_{t+1}}{2}}_{\text{Expectations Hypothesis}} = \underbrace{\frac{1}{2} Cov_t(m_{t+1}, \pi_{t+1}^e)}_{\text{Risk Premium}} - \left(\frac{1}{2} Cov_t(\pi_{t+1}, \pi_{t+1}^e) + \frac{1}{4} Var(\pi_{t+1}^e) \right) \quad (2)$$

We call inflation dynamics that lead to positive long-term bond risk premia “**bad**” inflation, and inflation dynamics that lead to negative bond risk premia “**good**” inflation. Equation (2) shows that “bad” inflation corresponds to the case where $Cov_t(m_{t+1}, \pi_{t+1}^e) > 0$ and “good” inflation corresponds to $Cov_t(m_{t+1}, \pi_{t+1}^e) < 0$. The last terms in equations (1) and (2) are Jensen’s inequality adjustments converting between log and level returns.

The intuition for the risk premium is most clearly illustrated by the simple expression

Figure 1. Stock and Bond Valuations and Long-Term Inflation. This figure shows Robert Shiller’s price-earnings ratio (CAPE), 10-year Treasury bond yield, and 10-year annualized CPI inflation from January 1952 through July 2022. The line representing inflation is constructed by adding 2% to the 10-year annualized inflation. Panel A presents the data in levels, Panel B in 12-month changes. The horizontal line in Panel B indicates January 2000. All data is from Robert Shiller’s website <http://www.econ.yale.edu/~shiller/data.htm>, accessed 9/29/2022.



for the one-period interest rate in equation (1). A particularly simple case of equation (1) obtains when there is no uncertainty about the SDF and investors are *risk neutral*. In this

case, the risk premium term is zero and nominal interest rate simply equals the real interest rate plus expected inflation, or the famous *Fisher equation*.²

Equation (1) illustrates the role of inflation dynamics for the one-period bond. It shows that for short-term bonds inflation is “bad” if it has a positive covariance with the stochastic discount factor, or if inflation occurs in states of the world when the SDF is high and investors value asset payoffs particularly highly. Intuitively, with a positive inflation-SDF covariance nominal Treasury bonds are worth less exactly in the states of the world that investors value the most, and hence must offer investors a positive risk premium as a sweetener. Conversely, if the inflation-SDF covariance is negative, inflation is “good” because it raises the value of nominal Treasury bonds when investors value payoffs most (i.e., in high SDF states). Nominal Treasury bonds are therefore valuable hedges, and investors are willing to hold them even if the offered risk premium is negative. While the expression for the one-period bond is intuitive, this is merely illustrative as inflation is rarely a problem at very short horizons. By contrast, due to its persistent properties inflation can be very significant for long-term bonds. Equation (2) uses the two-period bond to illustrate that the intuition of “good” and “bad” inflation transfers to long-term nominal interest rates, though in this case the risk premium depends on the covariance between *expected* inflation with the stochastic discount factor.

Can we express notion of “good” and “bad” inflation in terms of the business cycle properties of inflation? Under constant relative risk aversion (CRRA) preferences over aggregate consumption, utility of the representative agent is given by $U(C_t) = \frac{C_t^{1-\gamma}}{1-\gamma}$, with risk aversion parameter γ and the log SDF specializes to $m_{t+1} = \log\left(\beta \frac{U'(C_{t+1})}{U'(C_t)}\right) = \log\beta - \gamma\Delta c_{t+1}$, where β is a constant discount rate. This SDF implies that assets that pay out when consumption is low are more valuable to investors than assets that pay out when consumption is high. The risk premium for the pricing equation for the two-period nominal bond then becomes

$$Cov_t(m_{t+1}, \pi_{t+1}^e) = -\gamma Cov_t(\Delta c_{t+1}, \pi_{t+1}^e) \quad (3)$$

The risk premium in equation (3) shows that inflation is of the “bad” variety if inflation expectations rise when consumption growth is low, giving rise to the so-called “stagflations.” As a result, in recessions, prices of nominal Treasury bonds fall together with risky consumption claims or stocks. Thus, bonds also become risky, and investors require a positive risk premium to be willing to hold them. “Good” inflation, on the other hand, corresponds to the case where expected inflation rises when consumption and economic activity are high.

²Equation (1) follows from a simple no-arbitrage relationship for one-period nominal bond, and thus in itself does not allow causal interpretation. For example, the fiscal theory of the price level (Cochrane (2001)) emphasizes causal implications of (1) running from nominal bond prices and yields to inflation expectations.

In this case, real payoffs of nominal Treasury bonds become more valuable during recessions, making nominal Treasury bonds desirable hedges.

How should stocks depend on inflation? The early literature hypothesized that since dividends are a claim to firms' real profits, stocks should preserve their real value in the face of inflation and be uncorrelated with inflation. In contrast, empirical studies found that stock returns were negatively correlated with inflation in the 1970s and 1980s (Fama and Schwert (1977), Kaul (1987)). This led to an interest in understanding which fundamental shocks might drive the value of stocks down and erode the value of long-term bonds through higher inflation expectations at the same time. Because the covariance between bond returns and the SDF determines risk premia, and the bond-stock correlation can raise the overall volatility of a typical long-term portfolio divided between stocks and bonds, it is important to understand the economic drivers of this moment. We turn to this next.

2.1 “Good” and “bad” inflation in a simple New Keynesian Model

Consumption-based SDFs link risk discounts in financial markets to underlying fundamentals, but they do not teach us about the economic forces driving inflation and output or consumption, and their comovement. Before returning to asset pricing implications, it is useful to revisit the key insights from the workhorse three-equation New Keynesian model from macroeconomics.

The traditional New Keynesian model can be summarized by the following three log-linearized equations³

$$\text{Euler Equation: } x_t = (1 - \rho^x)E_t x_{t+1} + \rho^x x_{t-1} - \psi(i_t - E_t \pi_{t+1}) + v_{x,t}, \quad (4)$$

$$\text{Phillips Curve: } \pi_t = \kappa x_t + (1 - \rho^\pi) E_t \pi_{t+1} + \rho^\pi \pi_{t-1} + v_{\pi,t}, \quad (5)$$

$$\text{Monetary Policy Rule: } i_t = \rho^i i_{t-1} + (1 - \rho^i) (\gamma^x x_t + \gamma^\pi \pi_t). \quad (6)$$

Because we are interested in comovements between inflation and output, a constant risk premium is suppressed along with all other constants without loss of generality. Here, x_t denotes the output gap, or log real output relative to a frictionless price benchmark, and is the main indicator of whether the economy is in an expansion or a recession. The simplest models also assume that consumption equals output, so x_t should be thought of as closely linked to the real consumption that determines the SDF in consumption-based models of

³Full microfoundations of the three-equation New Keynesian model are developed in textbooks such as Galí (2015) and Woodford (2003), and the review article Clarida et al. (1999), so we do not attempt to provide them here. The backward-looking terms in (4)–(6) are needed to generate meaningful macro dynamics (e.g., Fuhrer, 1997) and can be motivated, for example, by habits (Fuhrer, 2000) or sticky information (Mankiw and Reis, 2002; Auclert et al., 2020).

asset prices.

The Euler equation (4) represents the consumer’s first-order condition for the real risk-free bond, describing the intertemporal trade-off between consumption today versus consumption tomorrow. By raising interest rates, monetary policy makes it more attractive to save and less attractive to borrow, driving down real consumption and output on the left-hand-side of (4). The demand shock $v_{x,t}$ represents anything that can increase consumption and output at a given risk-free rate, such as shocks to the demand for safe assets or credit market frictions.

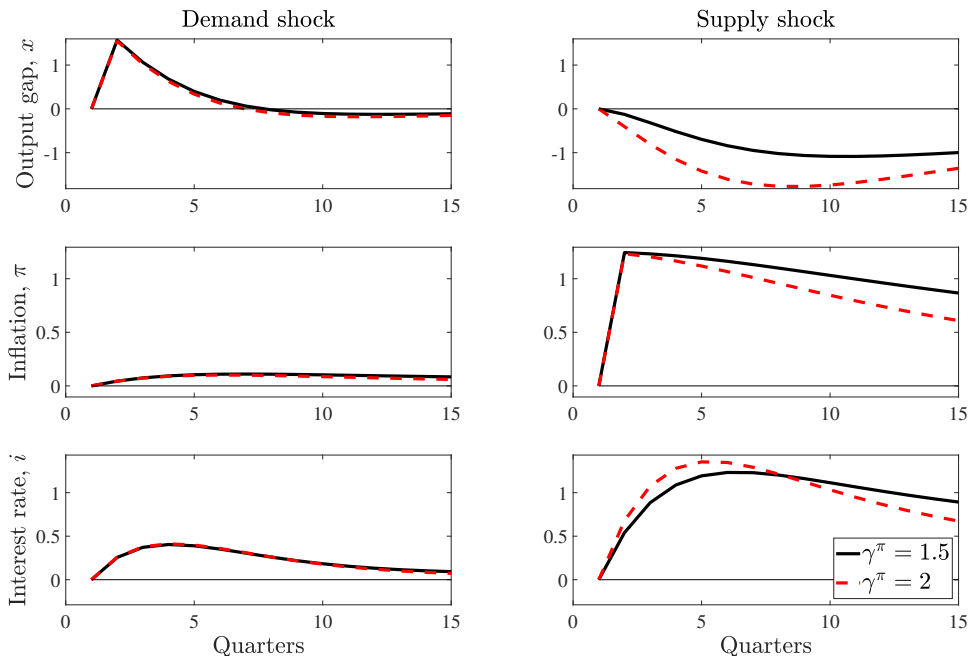
The Phillips curve (5) follows from firms’ optimal price-setting and production decisions when opportunities to revise prices are infrequent (Calvo (1983)). The backward-looking term may represent the dependence of inflation expectations on past realized inflation, or price indexation to past inflation. The supply shock $v_{\pi,t}$ captures any disturbance to the relationship between the output gap and marginal costs of production, such as increases in wage bargaining power or changing optimal markups due to partially monopolistic competition.

Finally, monetary policy is conducted in terms of a rule for the nominal policy rate, in the tradition of Taylor (1993). It consists of a backward-looking or inertial term, $\rho^i i_{t-1}$ and the monetary policy target $\gamma^x x_t + \gamma^\pi \pi_t$, to which the monetary policy gradually adjusts.

Figure 2 illustrates how demand and supply shocks affect the macroeconomy and the policy rate using calibrated parameter values from the existing literature. The output gap is in percent and inflation and interest rates are in annualized percent units. We show responses to a one percentage point demand shock and a one percentage point (in annualized units) supply shock. The right column in Figure 2 shows that supply shocks are stagflationary, inducing the “bad” inflation variety. A supply shock leads to a large and persistent increase in inflation, just as the output gap falls. The left column in Figure 2 shows that demand shocks, on the other hand, produce a more benign inflation, which is less volatile, less persistent, and occurs in expansions. Intuitively, stronger demand puts pressure on the costs of producers, thereby driving up inflation through the Phillips curve (5). However, if the Phillips curve is relatively flat and strongly backward-looking, as in Rotemberg and Woodford (1997) or recently estimated by Hazell et al. (2022), inflation resulting from demand shocks is quantitatively smaller than that resulting from supply shock, consistent with a dominance of demand shocks and low inflation volatility during the 2000s.

Figure 2 also illustrates how monetary policy can intermediate the effects of supply and demand shocks. The dashed line shows impulse responses with an alternative monetary policy rule that is more hawkish towards inflation ($\gamma^\pi = 2$). In the right column, under this more anti-inflationary policy stance, the policy rate rises more, leading to a stronger decline in the output gap and hence a deeper recession. As such, supply shocks matter more for the real output if monetary policy reacts to them (Bernanke et al. (1997)). At

Figure 2. Impulse Responses in a Standard New Keynesian Model. This figure shows impulse responses to demand and supply shocks. The output gap is in percent and inflation and interest rates are in annualized percent units. We show responses to a one percentage point demand shock and a one percentage point (in annualized units) supply shock. Quarter 1 is when the shock happens, with quarters after the shock shown on the x-axis. We set $\rho^x = 0.45$ and $\psi = 0.27$ as in Pflueger and Rinaldi (2022) following Fuhrer (2000); $\rho^\pi = 0.8$ following Fuhrer (1997); $\kappa = 0.019$ from Rotemberg and Woodford (1997); $\gamma^x = 0.5$ and $\gamma^\pi = 1.5$ following Taylor (1993). The red dashed line uses a higher policy inflation coefficient $\gamma^\pi = 2$.



the same time, inflation returns to target more swiftly. Note that inflation risk in Treasury bonds depends on the covariance between inflation and consumption growth in equation (3), and this covariance becomes more negative when supply shocks lead to a deeper recession. The more hawkish monetary policy stance may therefore make inflation “worse” in terms of Treasury bond risks even while making it more short-lived. Pflueger (2022) makes a similar argument in a quantitative structural macro-asset pricing model with time-varying risk premia.

2.2 “Good” and “bad” inflation in bonds and stocks

Because standard New Keynesian models feature an SDF with constant risk aversion and constant uncertainty, they tend to imply prices of stocks and bonds that are excessively smooth over time compared to the data. To derive implications for risk discounts in financial markets and their variation over time, a model of the sources of inflation needs to be integrated with models of risk premia. Most of the approaches to pricing inflation risk within endowment economies have been applied to structural economic models. However,

gaps remain and this is an area of ongoing research.

Much of the earlier literature focused on model calibrations with “bad” inflation and their ability to generate positive risk premia and an upward-sloping nominal term structure of interest rates. Piazzesi and Schneider (2006) brought to the fore the fact that over the second half of the 20th century high inflation tended to predict poor future consumption, and therefore, nominal Treasury bonds were unattractive assets to hold. They build on Epstein and Zin (1989) preferences to show that empirically plausible dominance of “bad” inflation can explain an upward-sloping nominal yield curve, in contrast to the typically downward-sloping real yield curves in CRRA consumption-based models. While Piazzesi and Schneider (2006) model implies constant risk premia, Bansal and Shaliastovich (2013) incorporate the “bad” inflation logic within a long-run risk model that features two sources of time-varying uncertainty—real and nominal—and show that it can generate plausible risk premium variation in stocks, bonds, and currencies. Rudebusch and Swanson (2012), Swanson (2019), and Kung (2015) embed this logic in Dynamic Stochastic General Equilibrium (DGSE) models. Gabaix (2012) and Miller et al. (2022) consider rare disaster models where disasters are inflationary. They argue that devaluation of nominal Treasury bonds during such a high marginal utility state can justify an upward-sloping term structure, and potentially a decline in the term premium over time.

However, as the Great Inflation of the 1980s was followed by the Great Moderation of the mid-1990s and 2000s, researchers noted that nominal Treasury bonds no longer correlated positively with stocks. Instead, bond returns started to display a negative correlation with stocks, meaning that nominal Treasury bond prices increased when there was bad news for stocks (Connolly et al. (2005), Andersen et al. (2007), Baele et al. (2010), Viceira (2012)). An extreme example of this behavior of Treasury bonds occurred during the financial crisis of 2008–2009 when Treasury bond prices rose just as the stock market fell, though the negative bond-stock correlation was first noted in the early 2000s. Over this period, inflation also became more positively correlated with the business cycle.

This change from “bad” to “good” inflation around the turn of the millennium was initially studied in reduced-form models of the SDF. Campbell et al. (2017) allow for a time-varying covariance between the SDF and inflation to work out the implications of changing inflation dynamics for the time-series of Treasury bond risk premia. Invoking the New Keynesian intuition—but no formal model—on the effects of supply and demand shocks, they argue that during earlier decades inflation rendered nominal Treasury bonds risky, justifying a positive term premium. By contrast the negative nominal bond-stock return correlation post-2000 led Treasury bonds to be valuable hedges, lowering the term

premium.⁴ To quantify the contribution of different shocks to the asset price dynamics, [Cieslak and Pang \(2021\)](#) exploit theoretically-motivated sign restrictions on the comovement between stocks and nominal Treasury yields as well as on the impact of shocks on the slope of the yield curve. They emphasize two independent sources of variation in risk premia, that are consistent with the changing correlations emphasized in equation (3). In particular, they attribute the change in stock-bond comovement in the late 1990s to a diminished role of the ‘common’ risk premium and monetary news (both of which move stocks and bonds in the same direction), and increased importance of real cash-flow growth news and, in particular, ‘hedging’ premium news (whereby nominal bonds hedge recession risk in stocks).

Recent literature explaining the changing nature of inflation risk endogenizes time-varying risk premia in stocks and bonds by building on the habit formation preferences of [Campbell and Cochrane \(1999\)](#). Most simply, these preferences can be thought of as inducing time-variation in risk aversion γ in equation (3). This time-variation is nonlinearly linked to the business cycle, where risk aversion increases after a sequence of bad consumption and output surprises. The first attempt to explain the changing nature of inflation risk in this framework is provided by [Campbell et al. \(2020\)](#). Their preferences jointly generate high stock market volatility and smooth short-term interest rates as in the data, and an exactly log-linear New Keynesian Euler equation, thereby taking a step towards integrating the favorable asset pricing properties of [Campbell and Cochrane \(1999\)](#)’s habit preferences with a New Keynesian model. The key insight from allowing for time-varying risk aversion through habit formation preferences is that a small change in the macroeconomic comovement between inflation and output can be sufficient to dramatically change the risk properties of nominal Treasury bonds. Changes in the inflation-consumption correlation endogenously lead to a switch from common variation in risk discounts in bonds and stocks to negatively correlated risk discounts, consistent with the decomposition of [Cieslak and Pang \(2021\)](#). The intuition is that the negative inflation-output correlation in the 1980s induces a positive correlation between the real payoffs of nominal Treasury bonds and stocks. In the “bad” inflation regime, an increase in risk aversion γ increases risk premia on bonds and stocks at the same time, amplifying the positive comovement between stocks and nominal Treasury bonds. Conversely, during the “good” inflation regime of the 2000s, an increase in risk aversion γ increases risk premia on stocks but makes risk premia on nominal Treasury bonds even more negative. A sudden increase in risk aversion therefore drives risk premia on bonds and stocks in opposite directions and amplifies the negative comovement between nominal

⁴This evidence of changing bond-stock covariance gave rise to a literature on regime changes, e.g., [David and Veronesi \(2013\)](#), [Song \(2017\)](#), [Bianchi et al. \(2022\)](#), and [Bianchi et al. \(2022\)](#). [Bauer et al. \(2022\)](#) use cross-sectional data from surveys to argue that slowly changing perceptions about the monetary policy regime can explain the secular movements in long-term bond risk premia.

Treasury bonds and stocks. This mechanism can be interpreted as endogenous “flight-to-safety”, which arises only if “good” inflation dynamics provide an initial seed of safety for nominal Treasury bonds.

Pfueger and Rinaldi (2022) and Pfueger (2022) build on this research and unify it with the New Keynesian drivers of inflation discussed in Section 2.1. Pfueger and Rinaldi (2022) show that such a model can explain persistent risk premium responses to monetary policy surprises, as a hawkish monetary policy shock drives down consumption towards habit, thereby making investors more risk averse and leading stock prices to fall more than the present discounted value of dividends.⁵ Pfueger (2022) fits a New Keynesian asset pricing model with habit formation preferences to macroeconomic data from the 1980s and the 2000s.⁶ She finds that the economy has switched from volatile supply shocks during the 1980s to volatile demand and monetary policy shocks in the 2000s, and this can explain the switch from “bad” inflation and risky nominal Treasury bonds to “good” inflation and safe nominal Treasury bonds. However, the constellation of macro shocks is not the only contributor to the safety of nominal Treasury bonds during the 2000s. Monetary policy has also changed towards a stance that is less likely to generate a deep recession after a positive supply shock, making supply-driven inflation less “bad” for nominal bonds.

3 Empirical evidence on inflation effects in asset prices

3.1 Inflation expectations

The basic intuition from the Fisher equation suggests that the level of nominal interest rates should be related to inflation expectations. Indeed, Figure 1 makes it difficult to refute that such a link exists, at least in the long run.

To visualize the properties of inflation expectations, Figure 3 displays inflation forecasts at different horizons using the Survey of Professional Forecasters (SPF), augmented with a ten-year ahead expected inflation measure from the Federal Reserve in the early part of the sample. The graph reveals a distinct properties of inflation in the short- and longer-run. The short-run component, driven primarily by volatile food and energy prices, mean-reverts within just a few quarters. The persistent inflation shocks, instead, give rise to the so-

⁵Kekre and Lenel (2022) obtain qualitatively similar time-variation in risk premia by modeling the redistributive effects of monetary policy, though rare disasters are needed as an additional channel to explain the average equity premium.

⁶Building on the DSGE framework with recursive preferences, Gourio and Ngo (2020) and Li et al. (2022) attribute the changing risks of Treasury bonds to changes in the conduct of monetary policy and the zero-lower-bound. These papers do not allow for changes in the volatilities of supply vs. demand and monetary policy shocks driving the economy, or time-varying risk aversion.

called trend inflation. Such shocks can linger around for years as seen in the early 1980s, suggesting considerable sluggishness in how the public updates their inflation beliefs (e.g., [Sargent, 1999](#); [Kozicki and Tinsley, 2001b](#)). Accordingly, [Malmendier and Nagel \(2016\)](#) show that survey forecasts of inflation can be well described by models of adaptive expectations (constant-gain learning), whereby agents learn from their past experience. Given this evidence, the backward-looking nature of inflation expectations (as in equation (5)) has become an increasingly common assumption in macro-asset pricing literature.

Another notable feature of inflation expectations at longer horizons is their high volatility in the 1970s and 1980s and stability starting around the turn of the 21st century. The 1980s inflation had several “bad” features, being volatile, persistent and—importantly for the risk of nominal Treasury bonds—high in recessions. The change in the properties of inflation expectations coincides with the switch in the stock-bond comovement from positive to negative. Combining these empirical facts with the intuition from the New Keynesian model supports the view that trend inflation originated mainly from the supply-side shocks, and that these shocks must have been relatively modest in recent decades compared to the early part of the sample. To the extent that “bad” inflation shocks take a long time to dissipate, the theory reviewed above predicts that asset pricing implications of trend inflation can be profound.

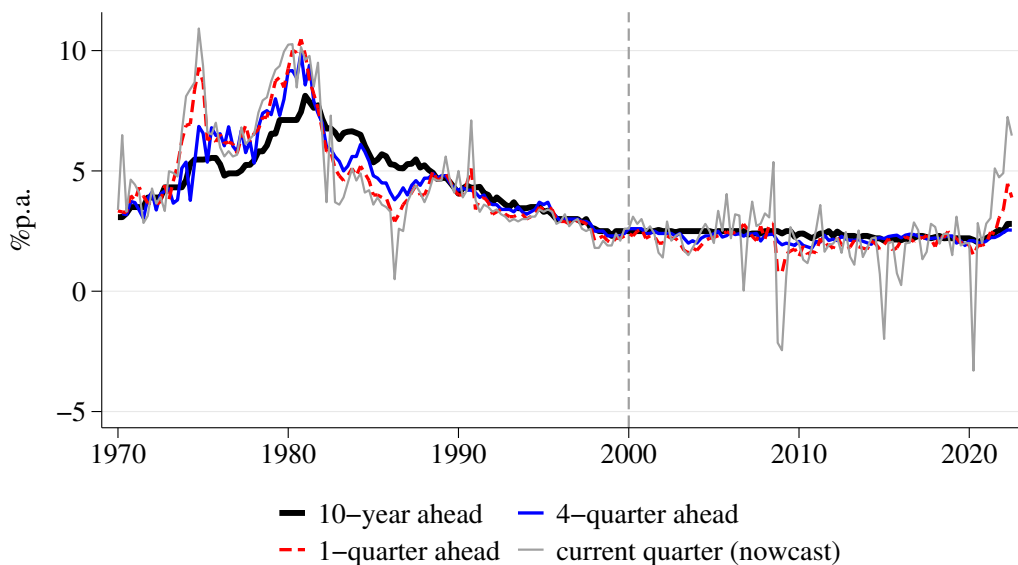
Next, we summarize evidence from different strands of empirical literature on bond return predictability, cross-sectional asset pricing, and derivatives pricing to highlight the asset-pricing implications of inflation risk.

3.2 Time-variation of bond risk premia

Inflation affects the term structure of nominal interest rates via investors’ expectations of the short-rate path (the expectations hypothesis term) and because investors require a risk premium for bearing inflation risk. By an accounting identity, knowing the expected path of the short rate has immediate implications for understanding bond risk premia, and vice versa. Much of the empirical yield curve research focuses on disentangling these two channels.

By now, it is well-established that risk premia on nominal Treasury bonds fluctuate over time. A common approach to measuring the risk premium variation uses predictive regressions, i.e., projections of future realized excess returns on today’s conditioning variables. Current yields are natural conditioning variables as they impound information about investors’ expectations. Accordingly, [Fama and Bliss \(1987\)](#) and [Campbell and Shiller \(1991\)](#) document significant predictability of bond returns with the term spread. [Cochrane and Piazzesi \(2005\)](#) expand on this result to show a powerful predictive content of a single factor

Figure 3. Term structure of inflation expectations. The figure presents CPI inflation expectations for different horizons from current-quarter nowcast up to 10-year-ahead forecast. The 10-year forecast is constructed from the survey-based measure used by the Federal Reserve (the perceived inflation target variable (PTR) in the FRB/US model). After 1991Q3, the Fed measure uses the 10-year CPI inflation forecast from the SPF. For shorter horizons, starting from 1981Q3, we use SPF quarterly CPI inflation forecasts and, before 1981Q3, the quarterly GDP deflator forecasts (adjusting for the mean difference between CPI inflation and GDP deflator). The sample spans 1970Q1 through 2022Q3.



constructed as a linear combination of multiple current yields.

Those findings have stimulated active research into the nexus between the variation in bond risk premia, the persistent dynamics of nominal yields, and the trend inflation. Starting from the premise of the Fisher equation, [Cieslak and Povala \(2015\)](#) show that trend inflation together with the current one-period yield span nearly perfectly the expectations hypothesis component of the yield curve, jointly capturing the real-rate and inflation expectations of investors. Controlling for the expectations hypothesis term allows to uncover the variation in the Treasury risk premium in longer-term yields. This leads to a simple characterization of the entire yield curve in terms of three factors—trend inflation, expected real rate, and the risk premium—which can be readily measured in the data.

Perhaps not surprisingly given [Figure 1](#), trend inflation has been found to drive the level of interest rates in the long run and across maturities (see, e.g., [Kozicki and Tinsley \(2001a\)](#); [Bekaert et al. \(2010\)](#); [Rudebusch and Wu \(2008\)](#) for the US evidence and [Barr and Campbell \(1997\)](#) for the UK evidence). Indeed, [Cieslak and Povala \(2015\)](#) show that the trend inflation accounts for the bulk (more than 80%) of the unconditional variance of the overall US nominal yield level since the 1970s.⁷ The term structure slope, instead, reflects

⁷[Bauer and Rudebusch \(2020\)](#) emphasize the additional role of a trending equilibrium real rate (r-star)

movements in real-rate expectations at the business cycle frequency and the risk premium. The risk premium contributes the least to the unconditional variance of yields, but its effect strengthens with yield maturity. Intuitively, investors holding long-term nominal bonds are particularly exposed to negative consequences of trend-inflation shocks, and require a time-varying compensation for this exposure. Thus, an increase in the trend-inflation premium steepens the yield curve.⁸ As an additional property, nominal risk premia turn out to be effectively uncorrelated with investors’ short-rate expectations, which implies that macro-finance models need to allow for a non-trivial variation in risk aversion or uncertainty to match premia in the data.

While trend inflation dominates the level of nominal yields, at higher frequencies yield innovations primarily reflect real-rate and risk-premium news, rather than expected inflation news. Decomposing the variance of yield innovations, [Duffee \(2018\)](#) argues that expected inflation news explains only between 10% and 20% of yield innovations at quarterly and monthly frequencies in the post 1960s sample. [Cieslak \(2018\)](#) provides similar estimates studying sources of investors’ short-rate forecast errors since the early 1980s. These findings may appear to contradict the dominance of expected inflation in yield levels, but the two views can be readily reconciled. The low contribution of expected inflation shocks to yield changes and high contribution to yield levels is a natural consequence of high persistence and sluggish updating of inflation expectations, as apparent in the survey forecast ([Figure 3](#)). Importantly, this evidence does not imply that expected inflation shocks are unpriced by investors and, thus, irrelevant for bond risk premia. It merely confirms the finding from the bond predictability literature that term premia (earned in compensation for expected inflation and real rate shocks) move around with state variables other than expected inflation itself.

3.3 Pricing of inflation risk in the cross section of asset returns

Evidence from the cross-section of asset returns also supports the conclusion that investors care mostly about persistent movements in inflation, and less about transitory fluctuations. A useful metric for understanding the magnitude of how inflation risk affects asset prices is to measure the price of risk per unit of inflation-beta exposure, i.e., the discount attached to prices of financial assets that perform poorly when inflation goes up. In the tradition of beta-pricing models, one can estimate beta exposure by regressing excess returns on

for the level of the nominal yield curve post 2000.

⁸In general, the bond risk premium can vary both with compensation for expected inflation shocks and expected real-rate shocks. While there is relatively broad consensus that long-lasting “bad” variety inflation shocks historically have earned a positive risk premium, the sign of the real rate risk premium is still debated.

(innovations in) inflation (see e.g., [Bekaert and Wang \(2010\)](#), [Boons et al. \(2020\)](#)). In this spirit, [Fang et al. \(2022\)](#) take a step toward disentangling the effects of different inflation shocks by studying the pricing of core and energy inflation across asset classes, including stocks, bonds, real estate, and commodities. The core beta turns out to be consistently negative suggesting that none of these assets hedge the core inflation risk. A one-unit higher core-beta exposure (in absolute terms) raises the risk premium by 1 percentage point per year. Energy shocks, instead, do not appear to command a significant risk compensation. Importantly, the identification of the core premium in [Fang et al. \(2022\)](#) stems from the pre-2000 sample, providing another piece of evidence on the negative consequences of persistent inflation shocks.⁹ These findings, however, should not be interpreted as implying that energy shocks are irrelevant for asset prices, if oil price shocks eventually feed into core inflation (e.g., [Hamilton, 2013](#); [Meltzer, 2005](#)).

3.4 Inflation swaps and inflation-linked bonds

Perhaps the most direct insight into how investors price inflation risk can be gleaned from the inflation swap market. While closely related to the inflation-indexed Treasury bonds (TIPS), inflation swaps tend to be less affected by liquidity concerns (e.g., [Fleckenstein et al. \(2014\)](#); [Pflueger and Viceira \(2016\)](#)). Inflation swaps effectively isolate the inflation-driven component of nominal Treasury yields.¹⁰ As such, the swap rate captures the risk-neutral expectation of inflation, or the expected inflation rate adjusted for the inflation risk premium arising from the comovement between the real SDF and (expected) inflation (equation (2)). To trace out inflation risk premia over time one can thus compare the swap rate with actual inflation expectations of investors using surveys.¹¹

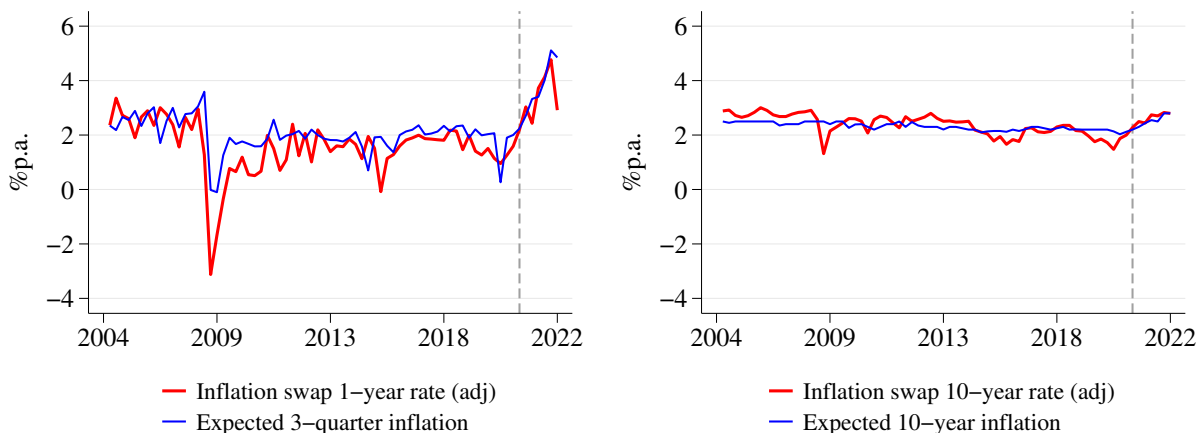
Figure 4 juxtaposes the survey inflation expectations against the one- and ten-year swap rates (adjusted for the indexation lag). If the inflation risk premium is negative (positive), we would expect the inflation swap rate to be below (above) survey inflation expectations. This simple exercise shows that properties of inflation risk premia inferred from inflation swaps agree broadly with the post-2000 implications of structural models, such as [Campbell et al. \(2020\)](#). At the short horizon, in the left panel of Figure 4, the inflation swap-survey spread is on average negative. As discussed in Section 2, a negative inflation risk premium suggests

⁹By leaving out volatile prices, core inflation is commonly viewed as a gauge underlying inflation trends, and therefore, is closely followed by investors and policymakers (e.g., [Mishkin, 2007](#); [Bernanke, 2017](#)).

¹⁰A widely used contract is a zero-coupon inflation swap, which is executed between two counterparties at time 0 and has only one cash flow at maturity. A buyer of the swap agrees to pay a fixed rate (e.g., 5% p.a.) on a notional amount in exchange for floating payments tied to the realized inflation over a period equal to the swap's maturity (the typical contract has a 2.5-month indexation lag).

¹¹Alternatively, [Fleckenstein et al. \(2013\)](#) use a reduced-form no-arbitrage model use to infer inflation risk premia from inflation swaps and options, which requires a fully specified dynamic model.

Figure 4. Inflation swap rates and survey expected inflation. The figure superimposes zero-coupon one- and ten-year inflation swap rates and survey expectations of inflation. The vertical line marks the start of 2021. The swap rates are adjusted to account for the known component of the payoff due to the 2.5-month indexation lag in the swap contract. Since one-year inflation swap rate reflects investors’ expectations over approximately the next three quarters, we match it with the three-quarter ahead survey. Survey expectations are from the SPF. The sample is quarterly from 2004Q3 through 2022Q3.



that investors perceive inflation to be of the “good” variety. In contrast, at the ten-year horizon, in the right panel of Figure 4, the swap-survey spread is positive on average, albeit modestly so. Although consistent with investors paying a premium for protection against trend inflation, the modest size of the premium indicates that the perceived trend inflation risk post-2000 has been small, aligning with the stable long-run inflation expectations over that period.

4 Conclusion

We have reviewed the theoretical and empirical progress made towards understanding how inflation and investors expectations of future inflation affect financial markets. Most obviously, inflation expectations matter for assets that deliver fixed dollar payouts, like nominal Treasury bonds. However, as inflation ultimately is an endogenous variable, its asset pricing implications depend on the nature of the underlying structural shocks. The body of evidence suggests that persistent, long-lived, stagflationary shocks are costly. When inflation is of such a “bad” type, as was the case during the 1980s, prices of Treasury bonds and stocks fall simultaneously, and consequently, both require a risk discount to attract investors.

It is too early to draw definitive conclusions about the sources and consequences of the post-pandemic surge inflation. For now, evidence from the inflation swap market and long-

term inflation forecasts from surveys indicates that inflation risk premia have remained very narrow. An optimist may feel a relief that inflation risk continues to be small, a pessimist may worry that, given that beliefs take time to adjust, financial markets may be too optimistic and the worst is yet to come.

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