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Monetary Policy When the Central Bank Shapes Financial-Market Sentiment

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In the years since the global financial crisis of 2008–2009, the conduct of monetary policy has changed markedly. As central banks sought to stimulate the macroeconomy with lower interest rates, but then bumped up against the zero lower bound on short-term policy rates, they began to experiment with other tools, most notably by buying large amounts of financial assets—that is, by engaging in quantitative easing or "QE"—to raise the prices of these assets and lower their yields.

While Ben Bernanke was Chair of the Federal Reserve, he joked that "the problem with QE is that it works in practice but not in theory" (Bernanke 2014). Figure 1 displays some broad evidence consistent with the works-in-practice view. The graph shows three prominent measures of financial conditions. The first is the ratio of stock prices relative to an average of corporate earnings over the prior ten years. This ratio is driven in part by the rate at which market participants discount earnings, with higher multiples indicating lower discount rates, all else being equal. The second measure is based on survey responses from US banks and indicates the net percentage of banks that are tightening their lending standards for new commercial and industrial loans. This variable is a proxy for whether bank credit is becoming harder or easier to obtain, with lower values indicating easier credit conditions. Finally, the third measure is an estimate of the "term premium" on a

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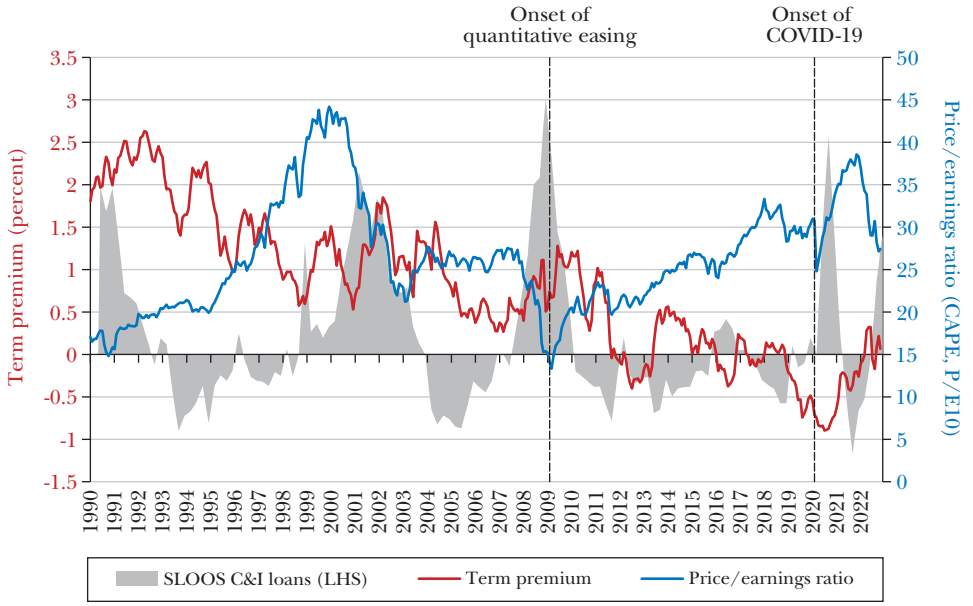
Figure 1
Evolution of Stock Prices, Treasury Term Premiums, and Bank Lending Standards During the Quantitative Easing Era



Source: For data sources and the underlying calculations, see Kashyap and Stein (2023).
Notes: The blue solid line plots Robert Shiller's cyclically adjusted price-earnings ratio (CAPE). The red solid line plots estimated values of the Treasury term premium, based on the methodology of Kim and Wright (2005). The grey shaded area shows the net percentage of domestic banks tightening standards for commercial and industrial (C&I) loans to large and middle-market firms, from the Federal Reserve Senior Loan Officer Opinion Survey (SLOOS). For graphical convenience, this SLOOS series is rescaled to have the same approximate range as the term premium series. The sample period runs from 1990 to 2022.

ten-year zero-coupon Treasury bond. One component of a ten-year bond's yield reflects the so-called expectations hypothesis—the idea being that the ten-year rate should resemble the expected average of short-term rates over the next ten years. The other component of the longer-term yield, the term premium, is the additional compensation above and beyond this expectational piece. When the term premium is high, it means that investors are demanding more compensation for the risk associated with investing for longer periods (and vice-versa).

Figure 1 shows that, according to all three of these measures, financial conditions loosened considerably with the initiation of quantitative easing by the Federal Reserve in 2009 and remained relatively loose for the next decade, up until the onset of the COVID-19 pandemic in March 2020. In particular, price-earnings ratios on stocks were generally rising during this period, bank lending standards were relaxed, and term premiums on US Treasury bonds were well below their historical averages. The low values of Treasury term premiums may not be all that surprising

given that the Fed was directly buying Treasury securities, but the movement in the other measures is not mechanically linked to the Fed's purchase programs.

As Bernanke's comment suggests, during the early days of quantitative easing, practice was running ahead of theory, in the sense that conventional macroeconomic models did not offer a clear explanation for *why* central bank asset purchases should have such widespread effects on asset prices. In recognition of this gap in understanding, both theoretical and empirical research began to focus increasingly on a variety of institutional and behavioral frictions absent from traditional models in an effort to better understand the mechanisms of quantitative easing. As we discuss in detail below, once researchers began to take these frictions more seriously, it became clear that they not only help to explain the workings of quantitative easing, they also offer a new and powerful way of thinking about the channels of influence of plain-vanilla conventional monetary policy—that is, policy implemented solely through changes in short-term interest rates such as the federal funds rate.

In particular, it now appears clear that both conventional and unconventional monetary policy actions gain much of their traction over the real economy by influencing a range of risk premiums in financial markets, where the risk premium on an asset is the expected return that an investor can expect to earn above and beyond the safe rate on a government bond of comparable maturity. When risk premiums are low, this can be thought of as a time when investors are either relatively risk tolerant, or relatively optimistic, so they drive asset prices up, and hence push future expected returns down. The work we review below, which is also discussed in the companion paper in this symposium by Bauer, Bernanke, and Milstein, documents that an easing of monetary policy tends to reduce risk premiums on a range of financial assets, including stocks, Treasuries, corporate bonds, and foreign exchange. Similarly, easy monetary policy tends to make banks more willing to accept a lower return for taking the credit risk associated with the loans they make.

These policy-induced movements in risk premiums, like movements in risk premiums more generally, tend to be temporary, meaning that an increase in asset prices spurred by central bank action is typically reversed in the months or years that follow. One way to summarize these findings is to say that central banks have a broad ability—through both their conventional and unconventional policies—to influence financial-market "sentiment," which we use as a synonym for the time-varying risk premiums on both traded securities and intermediated loans. For example, when credit spreads are compressed because bond prices have been bid up and the objective expected return to bearing credit risk is unusually low, we will say that credit-market sentiment is elevated. In this usage, elevated sentiment can reflect either a change in a rational investor's attitude toward risk—that is, a willingness to knowingly accept lower returns—or behavioral mistakes of various sorts that lead investors to be overly optimistic about future outcomes. For much of what follows, we can be agnostic as to which of these two mechanisms is at work. Either way, this channel of monetary-policy transmission is very different than what is envisioned in traditional textbook models.

The central thesis of this paper is that once one appreciates that monetary policy achieves much of its effectiveness through its impact on financial-market

sentiment, one may think quite differently about certain issues in the conduct of policy. To see why, it helps to connect to a second strand of recent work, which documents the importance of what we call a "credit-bites-back" effect in homage to the seminal paper of Jordà, Schularick, and Taylor (2013). In brief, this literature finds that following periods of rapid credit growth, and especially when asset prices are elevated and risk premiums are compressed (that is, when sentiment is running high), the likelihood of a recession or a financial crisis significantly increases.

Taken together, these two lines of research suggest a potentially important tradeoff facing monetary policymakers. Accommodative policy can be quite powerful in raising asset prices and spurring aggregate demand, even if short-term interest rates are stuck near zero; this is the upside of the central bank's ability to stoke market sentiment with tools that affect risk premiums. However, this power comes with a potential downside as well, because elevated sentiment today is likely to reverse eventually, and in doing so, it may increase the odds of a recession at some later date. As we argue below, this tension becomes all the more pronounced when financial regulation is by itself unable to fully contain the credit-bites-back risks put into play by monetary policy.

New Theories about Monetary Policy Transmission

In canonical New Keynesian accounts of monetary policy transmission, time-variation in financial-market risk premiums does not play a meaningful role (for traditional models, see Woodford 2003; Galí 2008, 2018). In these models, when the central bank cuts the short-term nominal rate, the assumption of price stickiness implies that it also lowers the short-term real interest rate. If monetary policy changes are persistent, there will be an associated impact on longer-term real rates as well; these in turn will influence consumption and investment decisions. This story can largely be told in a world where all risk premiums are constant over time.

A similar observation applies to other familiar accounts of the monetary transmission mechanism, such as the "bank lending channel" (Kashyap and Stein 2000; Drechsler, Savov, and Schnabl 2017). Here, an easing of monetary policy allows banks to raise additional deposits and expand their lending. This could be, for example, because in a low-interest-rate environment, banks do not have to compete as aggressively for retail deposits with higher-yielding alternatives such as money-market funds. In this theory, what changes for banks as monetary policy varies is not their risk tolerance, but rather their liquidity position, and hence their ability to finance their lending activity. The broader macro literature on the financial accelerator, as summarized by Bernanke, Gertler, and Gilchrist (1999), relies on the idea that as collateral values increase in good times, households and firms are able to borrow more and hence expand economic activity, but it also does not emphasize time-varying risk premiums as a central factor in policy effectiveness.

By contrast, a body of recent work has put changes in investor and intermediary willingness to bear risk front and center in its account of monetary policy. We

begin here with a brief discussion of the underlying theories; in the next section, we review four new facts that support these theories.

Changes in central-bank policy rates might affect the willingness of investors and intermediaries to take risk, and hence the risk premiums on a range of financial assets, through several channels. For example, one idea is based on the premise that investors face a sustainable spending constraint and can only consume the expected returns from their wealth—that is, investors do not wish to run down their wealth over time. This assumption seems to capture the behavior of endowments and sovereign wealth funds, as well as perhaps that of some individual retirees. Campbell and Sigalov (2022) build this assumption into a neoclassical model of consumption and portfolio choice featuring an infinitely-lived investor. The presence of a sustainable spending constraint naturally generates "reaching for yield" behavior: as the real interest rate falls, the investor tends to increase their portfolio's allocation to risky assets in an effort to partially maintain their level of current consumption.

Another approach emphasizes the ways in which agency or regulatory frictions can distort intermediary behavior (in the spirit of Rajan 2005; Borio and Zhu 2012). For example, Hanson and Stein (2015) build a model in which a set of intermediaries such as commercial banks care about maintaining their accounting income in the face of interest-rate cuts. This leads the intermediaries to take on more "duration risk" at such times—that is, to be more willing to hold longer-term bonds—which in their model puts downwards pressure on the term premium between long- and short-term debt. Chodorow-Reich (2014) and Di Maggio and Kacperczyk (2017) argue that periods of low interest rates may lead money-market funds to take more risk in order to cover their fixed costs and sustain their profit margins.

Drechsler, Savov, and Schnabl (2018) and Acharya and Naqvi (2019) take a somewhat different route, noting that accommodative monetary policy gives banks easier access to cheap liquidity, which serves an insurance role: they can afford to take on more risk without worrying as much about whether this additional risk might cause a disruptive liquidity shortfall.

A separate group of models sets aside these kinds of constraints and frictions, and instead focuses either on how monetary policy can affect the distribution of wealth or on explicitly behavioral factors. For example, Kekre and Lenel (2022) highlight the importance of heterogeneity in households' risk tolerance and argue that an interest-rate cut redistributes wealth towards more risk-tolerant households, thereby increasing aggregate risk appetite. Adopting a more behavioral perspective, Lian, Ma, and Wang (2019) find in randomized experiments that people exhibit a stronger preference for risky assets when the risk-free rate is lower, which they interpret as evidence that psychological mechanisms, such as reference points and salience, affect investor risk-taking in an important way. In another behavioral model, due to Fontanier (2022), a rate cut that initially raises asset values for purely fundamental discounted-cashflow reasons also causes investors who extrapolate from past price increases to become overly enthusiastic about future prospects, thereby causing an eventual overshoot of valuations.

Supporting Evidence on Monetary Policy and Risk Premiums

We review four patterns of facts that confirm the predictions of the above theories related to risk-taking. In particular, we discuss evidence on how changes in the stance of monetary policy influence: (1) the term premiums on government bonds; (2) stock market risk premiums; (3) the pricing of credit risk in both corporate bonds and in bank lending terms; and (4) foreign exchange risk premiums. In each case, looser monetary policy, whether it is initiated by interest rate changes or unconventional means such as quantitative easing, leads to lower risk premiums and hence easier financial conditions.

Fact 1: Treasury Term Premiums

Standard discussions of quantitative easing, like Bernanke (2020), point to its impact on the risk premiums of those specific assets that are being purchased by the central bank. It might not be terribly surprising, for example, if large-scale Fed purchases of long-term Treasury bonds lowered their yields relative to short-term interest rates, and hence compressed Treasury term premiums. What may be somewhat more surprising is the finding that even when monetary policy is implemented conventionally, with changes only in the short-term policy rate and the Fed not adding to its holdings of Treasury bonds, there is nevertheless a strong impact of monetary policy on Treasury term premiums.

One illustration of this pattern comes from Hanson and Stein (2015), who study the high-frequency reaction of real interest rates—as captured by the interest rates on Treasury inflation-protected securities—to monetary policy announcements. They find that monetary innovations have a surprisingly large effect on real rates far in the future. For example, if the two-year nominal Treasury yield goes up by 25 basis points in the immediate wake of a monetary policy announcement by the Federal Open Market Committee, this is associated with an 11 basis-point increase in the ten-year forward real rate. Hanson and Stein argue that this increase in the distant-forward real rate is unlikely to reflect a change in the expected path of short-term real rates at such a long horizon—which would require prices to be counterfactually sticky for an extremely long time—but rather a change in the Treasury term premium. In support of this point, they demonstrate that those movements in forward rates that occur on dates when the Federal Open Market Committee makes a policy announcement tend to largely mean revert over the next twelve months. This reversal effect is also suggestive of a change in risk premiums.

In a similar vein, Hanson, Lucca, and Wright (2021) find that since 2000, increases in short-term Treasury rates are associated with strong, yet temporary, upwards pressure on term premiums. They build a model in which changes in short-term interest rates trigger "rate-amplifying" shifts in the demand for long-term bonds, which might come from investors who either extrapolate recent changes in short-term interest rates, or who reach for yield when short rates fall.

Fact 2: Stock Market Risk Premiums

If the stock market reacts to monetary policy surprises, this can create another channel for monetary policy transmission. Bernanke and Kuttner (2005), using an event-study approach, find that a surprise cut of 25 basis points in the federal funds rate target is associated with a contemporaneous increase in the value of the stock market of about 1 percent. Perhaps more interestingly for our purposes, they show that the vast majority of the stock-price increase—on the order of 80 percent—is due to a change in the expected excess return, or risk premium, in the stock market. Concretely, they document that the initial upward spike in stock returns is followed by a period of abnormally low returns; that is, the boost to stock prices associated with a surprise monetary easing is in large part transitory and is eventually mostly reversed. In this symposium, Bauer, Bernanke, and Milstein show that these results continue to hold when the sample is updated through 2022 and when several different measures of monetary policy shocks are considered (see also Cieslak and Pang 2021). They also add another complementary result, namely that looser monetary policy additionally reduces the volatility of stock prices. These patterns are exactly what one would expect to find if the monetary-policy innovation led to an increase in investor risk tolerance.

Fact 3: Credit Spreads and Bank Lending Terms

The risk premium on corporate credit—that is, the expected return differential between risky corporate bonds and safe Treasury bonds—is one of the most important risk premiums that monetary policy can affect, given that risk premiums on corporate credit have been documented to have powerful effects on real economic activity (Gilchrist and Zakrajšek 2012; López-Salido, Stein, and Zakrajšek 2017). However, inference in this case is somewhat trickier than for the Treasury market and the stock market. Corporate bonds are less liquid, and less actively traded than stocks or government bonds, and so may reprice less promptly in the immediate aftermath of a meeting of the Federal Open Market Committee than do other securities. If so, a high-frequency event study looking at the hours just before and after a monetary policy announcement would be biased away from finding an effect of monetary policy on corporate credit spreads, especially if these spreads are measured directly based on the difference in corporate yields and faster-adjusting Treasury yields.

One response to this challenge is to look at longer-horizon effects. In this spirit, Gertler and Karadi (2015) use a vector autoregression to estimate the dynamic impact, at monthly frequency, of monetary-policy surprises on the Gilchrist and Zakrajšek (2012) "excess bond premium." The excess bond premium can be thought of as that portion of the credit spread that is not accounted for by expected default losses, and it therefore maps very closely into the concept of a credit-risk premium. Gertler and Karadi (2015) find that a monetary surprise that reduces the one-year Treasury bill rate by 25 basis points compresses the excess bond premium by 10 basis points in the first month. This effect persists for about eight months, and then is gradually reverted away, again consistent with the behavior of a transitory risk premium.

By its nature, however, this longer-horizon approach is inevitably more sensitive to the precise details of the econometric specification and the identifying assumptions used in estimation; as such, it lacks the appealing transparency and robustness of a high-frequency event study. Bauer and Swanson (2022) provide a detailed treatment of these issues. Interestingly, with their preferred approach to identification they find an even stronger effect of monetary policy surprises on the excess bond premium than do Gertler and Karadi (2015), although they are careful to highlight the sensitivity of these results to alternative specifications.

Another approach to address how monetary policy affects the pricing of credit risk is to revert back to the high-frequency event-study methodology, but to look at the spreads on credit default swaps instead of corporate bonds. Credit default swaps are a financial contract that allows the buyer of a bond to purchase insurance against the risk of the bond defaulting. The market for credit default swaps tends to be more liquid than the underlying bonds, and to have prices that adjust more rapidly, so they may be better-suited to a high-frequency approach. Indeed, using a methodology similar to Hanson and Stein (2015), Palazzo and Yamarthy (2022) find that, in the short window around a monetary policy announcement, a 25 basis-point increase in the two-year Treasury yield is associated with a 7 basis-point average increase in firm-level spreads in credit default swaps. They also uncover noteworthy heterogeneity in the response, with a larger effect being seen in the set of riskier firms that had higher spreads in their credit default swaps before the policy announcement.

Of course, when one thinks about the pricing of credit risk, it is important to go beyond the corporate bond market and also to consider bank lending. One might naturally expect some integration between the pricing of credit risk across corporate bonds and bank loans; for example, such a conjecture is consistent with the relatively high correlation between corporate credit spreads and bank lending terms as reported in the Federal Reserve's Senior Loan Officer Opinion Survey.[1]

As it turns out, an easing of monetary policy does in fact seem to lead banks to loosen their credit standards and take on more credit risk. For example, Paligorova and Santos (2017) use data on syndicated corporate loans from Dealscan to show that when short-term interest rates are low, there is a reduced sensitivity of the spread that a firm is charged on its loans to a measure of its fundamental credit risk; in other words, there is a lower cross-sectional price of credit risk. In a similar vein, Dell'Ariccia, Laeven, and Suarez (2017) exploit supervisory data from the Federal Reserve to look at how banks' internal risk ratings on newly originated loans vary with the stance of monetary policy. They find that when the policy rate declines, banks extend more credit to riskier borrowers. This is true even when they restrict the set of loans only to those that are new and not made under commitment, so that this choice is clearly discretionary. Maddaloni and Peydró (2011) use loan officer

[1] For example, over the period 1996:4–2022:2, the correlation in levels between the high-yield credit spread and a measure of easing of credit terms from the Federal Reserve's Senior Loan Officer Opinion Survey is –0.51. There is also a strong correlation between the opinion survey and corporate bond issuer quality, as noted by Greenwood and Hanson (2013).

survey data from both the United States and the euro area to document that times of low policy rates are associated with generally laxer lending standards.

These sorts of results hold across a range of other countries. Using credit registry data from Spain, Jimenez et al. (2014) find that when interest rates drop, the amount of lending to firms with bad credit histories (or future impending losses) rises relative to loans made to more creditworthy firms. They also show that this effect is more pronounced for loans made by weakly-capitalized banks than for those made by well-capitalized ones. Using data from Bolivia—a largely dollarized economy where monetary policy changes are exogenously transmitted from the United States—Ioannidou, Ongena, and Peydró (2015) show that a lower federal funds rate leads to relatively more lending by Bolivian banks to borrowers with worse credit histories, lower internal credit ratings, and who display poorer post-loan performance.

Thus, whether through banks or via bond markets, an important part of what happens when the central bank eases monetary policy is that the risk premium on corporate credit declines. Holding fixed both borrowers' creditworthiness and loan demand, we would expect to see lower policy interest rates followed by an expansion in overall credit creation, and one that is tilted towards higher-risk firms.

Fact 4: Foreign Exchange

Both long-term bonds and exchange rates are exposed to a common primary risk factor—namely, changes in the stance of monetary policy. With this observation in mind, Greenwood et al. (forthcoming) and Gourinchas, Ray, and Vayanos (2022) argue that there is likely to be a close correlation between bond market term premium differentials across countries on the one hand, and exchange-rate risk premiums on the other. Greenwood et al. (forthcoming) provide supporting evidence, showing for example that if the Federal Reserve undertakes a round of quantitative easing, it both reduces the term premium on US Treasury securities relative to term premiums in other countries, and also weakens the value of the US dollar—but only for a time, so that the dollar subsequently tends to appreciate by an abnormal amount going forward against other currencies. This finding offers yet another example of central-bank policy gaining additional traction to stimulate output in the short term by virtue of its ability to influence risk premiums.

Evidence on the Credit-Bites-Back Mechanism

With these four facts about monetary policy and risk premiums in hand, we now turn to the body of work that studies the credit-bites-back mechanism. Broadly speaking, this work highlights two other patterns of facts. First, if one looks at quantity data that captures the growth of aggregate credit, then at relatively low frequencies, rapid growth in credit tends to portend adverse macroeconomic outcomes, be it a financial crisis or some kind of more modest slowdown in activity. Second, elevated levels of financial-market sentiment—especially indicators which signal that the expected returns to bearing credit risk are low—also tend to carry

negative information about future economic growth, above and beyond that the information present in credit-quantity variables. Thus, the overall picture is that credit booms, especially those associated with both rapid increases in the quantity of credit and also aggressive pricing of credit risk, tend to end badly. The summary that follows draws heavily on Stein (2021).

With respect to the quantity-oriented evidence, some of the most influential research comes from Schularick and Taylor (2012) and Jordà, Schularick, and Taylor (2013). In the former, they study 14 developed countries over the period 1870–2008 and find that the growth of bank loans in the preceding five years is associated with a significantly increased probability of a financial crisis. In a similar spirit, Mian, Sufi, and Verner (2017) also focus on a quantitative measure of credit expansion, in this case the ratio of household credit to GDP. Using a sample of 30 mostly advanced economies and a panel running from 1960 to 2012, they find large negative effects of credit booms on future output: a one-standard-deviation increase in household debt to GDP over a three-year interval leads to a 2.1 percent decline in GDP over the following three years. Notably, these results reflect not just occurences of extreme financial crises, but are also driven by more moderate noncrisis recessions and slowdowns. Sufi and Taylor (2021) provide an excellent summary of the recent research on financial crises.

Turning to the connection between credit-market sentiment and future growth, López-Salido, Stein, and Zakrajšek (2017) investigate the role of sentiment in a US sample running from 1929 to 2015. To do so, they build on the work of Greenwood and Hanson (2013), who show that when credit spreads are narrow, and when the share of high-yield (or "junk bond") issuance in total corporate bond issuance is high, the expected returns to bearing credit risk are predictably low, and sometimes even negative—in other words, narrow credit spreads and an above-average high-yield share, taken together, are indicative of elevated credit-market sentiment. López-Salido, Stein, and Zakrajšek (2017) then show that exuberant credit-market sentiment in a given year t is associated with a decline in economic activity in years $t + 2$ and $t + 3$. Underlying this result is the existence of predictable mean reversion in credit-market conditions. When credit risk is aggressively priced, spreads subsequently widen. The timing of this widening is closely tied to the onset of a contraction in economic activity, one in which the pain is felt disproportionately by firms with lower credit ratings. Exploring the mechanism, they find that buoyant credit-market sentiment in year t also forecasts a change in the composition of external finance: net debt issuance falls in year $t + 2$ while net equity issuance increases, consistent with the reversal in credit-market conditions leading to an inward shift in credit supply.

This focus on the impact of investor sentiment on future economic outcomes is extended by Kirti (2018) in a sample encompassing 38 countries. His key finding concerns the *interaction* of growth in the quantity of credit with credit-market sentiment, where he follows Greenwood and Hanson (2013) and proxies for sentiment with the high-yield share of bond issuance. In particular, following strong credit growth, economic growth in the following three years is roughly 1.1 percent slower per year. However, if this increase in the quantity of credit is accompanied by a

two-standard-deviation increase in the high-yield share, growth over the next three years slips by a further 0.8 percent per year. Krishnamurthy and Muir (2020) present related findings, using a panel that goes back 150 years and covers 19 countries.

Greenwood et al. (2022) also analyze the interaction between credit growth and asset prices, using a panel of 42 countries over the period 1950 to 2016. They examine what happens when a country enters a vulnerable "Red Zone," characterized by business credit growth over the prior three years in the top quintile of the distribution, and stock returns over the same window in the top tercile. For countries in the Red Zone, the probability of a financial crisis rises dramatically—from a normal-times value of 7 percent over a three-year horizon to over 40 percent.

A related set of papers uses quantile regressions to explore how changing financial conditions affect not just mean or median outcomes, but the *full distribution* of real activity over a subsequent time period. For example, Adrian, Boyarchenko, and Giannone (2019) focus on the US evidence, while Adrian et al. (2022) also look at data from Australia, Canada, Switzerland, Germany, Spain, France, Great Britain, Italy, Japan, and Sweden. The general picture that emerges in both studies is that it is the lower tail of GDP growth—for example, the fifth percentile—that seems especially vulnerable in the two to three years following an easing of financial conditions. In other words, loose financial conditions seem to raise the downside risks to real activity, while having a weaker effect on the upper tail of the distribution.

What specific measures of financial conditions are most relevant in this sort of predictive exercise? Using US data, Carpenter et al. (2022) find that proxies for credit supply such as loan spreads or debt levels are more informative for downside risks to the economy than variables relating to equity markets or exchange rates. The idea that tracking the pricing of credit risk is especially important in this context echoes the findings of López-Salido, Stein, and Zakrajšek (2017), among others.

We believe that the above-discussed evidence is quite compelling in establishing two propositions: (1) accommodative monetary policy leads to reductions in risk premiums generally, and in credit risk premiums in particular; and (2) rapid credit growth and compressed credit risk premiums increase the odds of adverse economic outcomes at a horizon of between two to five years.

However for the purposes of using these empirical findings to draw implications for the conduct of monetary policy, two caveats should be noted. First, as pointed out by Boyarchenko, Favara, and Schularick (2022), there is limited evidence that it is specifically *monetary-policy induced changes* in credit growth and risk premiums—as opposed to changes driven by other factors—that create this economic vulnerability. As they note, establishing such a link is challenging, and more research on this specific issue would be valuable. We are going to make the leap and assume that the link is operative in what follows, but the reader should be aware that this presumption is not yet firmly established.

Second, any normative implications for monetary policy hinge on the extent to which the credit-bites-back risks we have identified can be mitigated by financial regulation. A traditional argument is that financial regulation should be the first line of defense against these risks (for example, Bernanke 2015). While agreeing

on the importance of robust financial regulation, Stein (2021) expresses skepticism about its ability to serve as a panacea. He notes that the limitations of financial regulation are likely to vary by jurisdiction, but are particularly acute in countries like the United States, where the majority of corporate credit creation now takes place outside the easier-to-regulate banking sector, and where various political-economy constraints have left policymakers with essentially nothing in the way of time-varying macroprudential tools that can be used to address a sharp deterioration in observed credit standards and quality. With this observation in mind, our implicit assumption in the remainder of the paper is that even after doing the best that one can with existing financial-regulation tools, there still remains—as in the historical data—a meaningful credit-bites-back effect.

A Model of Monetary Transmission via Credit Risk Premiums

In what follows, we describe a bare-bones framework in which one can examine the intertemporal tradeoff that arises when monetary policy influences credit risk premiums and when there is a credit-bites-back effect of the sort documented in the work discussed above. We proceed here by just describing our basic assumptions and conclusions. A more complete analysis of the model appears in the online Appendix. Other models that investigate similar issues are Caballero and Simsek (2020, 2022), Adrian and Duarte (2020), and Fontanier (2022).

The Textbook Case

To keep things simple, we assume that the central bank has no inflation mandate, so that its only responsibility is output stabilization. This assumption can be thought of as capturing a "divine coincidence" world where shocks only come from the demand side of the economy, and so stabilizing output also amounts to stabilizing inflation. A textbook rendition of the so-called IS (investment-saving) curve, which captures the effect of interest rates on spending (also known as "aggregate demand") is given by:

$$y_t = y^* - \gamma(r_t - r^*) + \epsilon_t,$$

where y_t is output at time t, y^* is potential output, r_t is the real interest rate, r^* is the natural rate of interest, and ϵ_t is an aggregate demand shock. In this textbook case it is easy to show that the central bank can stabilize output perfectly period-by-period, by raising (lowering) interest rates the appropriate amount in the face of a positive (negative) demand shock.

Adding Credit Spreads

To capture the financial-market effects we have been discussing, we now add credit spreads to the model and allow monetary policy to influence these spreads. To be clear, although we use the terms "credit" and "credit spreads" for concreteness in what follows, our analysis would apply equally to other risk premiums that

are influenced by monetary policy, such as the stock market risk premium, bank lending spreads, or term premiums in the Treasury market.

With this added bit of realism, the IS curve is modified as follows:

$$y_t = y^* - \gamma((r_t + s_t) - (r^* + s^*)) - \beta(s_t - s_{t-1}) + \epsilon_t,$$

where s_t is the credit spread at time t, and s^* is the steady-state value of the credit spread.

There are two changes to note here: first, what matters for aggregate demand now is not the real interest rate set by the central bank, but a broader notion of financial conditions, given by the current value of $(r_t + s_t)$ relative to its long-run average value of $(r^* + s^*)$. Second, and crucially, there is a "credit-bites-back" term, given by $-\beta(s_t - s_{t-1})$: output is reduced, all else equal, when credit spreads *increase* from the prior period. This might be because an increase in credit spreads impairs the health of financial intermediaries, and financial regulation is inadequate to fully prevent this damage. For example, a bank's capital might be reduced by an erosion of the perceived credit quality of its loan book, and this might in turn compromise its ability to make new loans. Or a corporate bond fund that experiences mark-to-market losses might see substantial outflows of money under management, which would dampen its demand for new bonds.

The time-t credit spread is in turn determined by:

$$s_t = s^* + \theta(r_t - r^*) + \upsilon_t,$$

where the $\theta(r_t - r^*)$ term captures what can be thought of as a reaching-for-yield effect—easy monetary policy tends to depress credit spreads—and υ_t is an exogenous credit-supply shock.

The parameter β is key to creating an intertemporal tradeoff for policy. To see why, suppose $\beta = 0$, so there is no credit-bites-back effect. In this case, output can again be perfectly stabilized in every period with a simple modification of the interest-rate rule. Relative to the simpler textbook case, the interest-rate rule in this case is changed in two ways. First, the policy rate is less responsive to demand shocks. This is because changes in the policy rate have an amplified impact on output, due to the reaching-for-yield effect. Second, policy leans against exogenous movements in financial conditions, as given by υ_t. When credit spreads are relatively low, the policy rate is higher, and vice-versa.

Thus, in this limiting case where $\beta = 0$, and there is no credit-bites-back effect, optimal monetary policy takes account of both exogenous changes in financial conditions, as well as its own impact on these conditions. Note, however, that to do so the central bank must be able to observe the exogenous credit supply shock υ_t precisely, which amounts to being able to separate these temporary shocks to credit conditions from more permanent shifts in steady-state credit spreads, as denoted by s^*. This informational requirement is potentially challenging. Nevertheless, if we provisionally assume that υ_t can be well measured, monetary policy faces no compromises or tradeoffs and is still able to perfectly stabilize output in every period.

This version of the model might be thought of as roughly in line with contemporary central-bank practice, whereby a good deal of attention is paid to financial conditions—and where evidence suggests that the policy rate is indeed set at a lower value, all else equal, when conditions are tight, and vice-versa (Peek, Rosengren, and Tootell 2016; Razzak 2022)—but where the intertemporal tradeoffs associated with policy-induced changes in financial conditions are generally not given explicit consideration, at least not in the formal models used to guide policy.

An Intertemporal Tradeoff

To see how an intertemporal tradeoff can arise, suppose instead that $\beta > 0$, so that a credit-bite-back effect exists. To simplify the exposition, we can focus on a two-period version of the model, where what matters are the policy rates r_1 and r_2 at times 1 and 2, respectively, and the tradeoffs these choices entail. Moreover, we assume that at an earlier time 0, the economy was in steady state, with $r_0 = r^*$, and with $s_0 = s^*$. To simplify even more, we further assume that there are no credit supply shocks at either time 1 or time 2, so that $v_1 = v_2 = 0$. Finally, the most interesting scenario arises when there are persistent recessionary pressures—that is, negative demand shocks—at both dates, and there is a possibility that things may get worse at time 2, to the point that the zero lower bound on interest rates may bind, meaning that the central bank may be unable to restore the economy to full employment at time 2 by cutting interest rates as far as this would require.

A richer model could also allow for other reasons, besides the zero lower bound, why policy might be unable to fully neutralize all relevant shocks to the economy: for example, perhaps the rapid unwinding of a financial bubble has an especially damaging effect on the credit-allocation mechanism. Alternatively, lags in the transmission of policy to the real economy may make it harder to offset negative shocks fully. However, to make our points as simply as possible we set aside these considerations and use the zero lower bound as a catchall for the idea that there may be times when monetary policy cannot perfectly offset all potential damage to the real economy.

In this configuration, we can demonstrate a number of propositions. In particular, if the zero lower bound binds at time 2, then: (1) the optimal policy rate at time 1 is higher than it would be if the zero lower bound were not binding at time 2; (2) output at time 1 is lower than it would be if the zero lower bound were not binding at time 2; and (3) it is no longer optimal for the central bank to offset negative time-1 demand shocks fully.

Intuitively, the central bank fears that if it cuts rates at time 1 enough to offset a negative demand shock fully, it will overheat credit conditions, and this overheating will create a drag on time-2 output that cannot be offset if the zero lower bound binds at time 2. This is the core intertemporal tradeoff that arises in our setting. Moreover, this time-1 timidity in providing accommodation is more pronounced when the anticipated negative demand shock at time 2 is larger in absolute magnitude—or, in a richer setting, when the likelihood of a severe zero lower bound episode is greater.

The upshot is that considerations of financial stability can, in some cases, make the central bank choose to stop short of hitting its full-employment mandate if hitting this mandate would require overheating financial markets to the point that employment in future periods is put at too much risk. Of course, it is well-understood that a central bank might stop short of hitting its full-employment mandate if inflation is running above its target, so tradeoffs of this general sort are familiar to central bankers. What is different in our setting is that the tradeoff is not between full employment today and inflation today, but rather between full employment today and full employment tomorrow, with the potential for financial-market reversals being the link that binds these two items together.

It is worth noting that in many discussions of the role of monetary policy in safeguarding financial stability, the question is framed as asking whether monetary policy should proactively "lean against the wind" of changes in financial-market sentiment (for example, Svensson 2017). This formulation would seem to suggest that fluctuations in asset prices are an exogenous source of variation—a "wind" blowing in from outside the model, as might be associated say, with a late 1990s-style stock-market bubble driven by enthusiasm over a new technology. However, as our framework underscores, sometimes the central bank is itself the driver of movements in asset prices. In this case, the question is not whether it should lean against an external shock, but rather how aggressively a central bank should deploy a tool that itself can lead to overly compressed risk premiums.

Implications for the Conduct of Monetary Policy

Incorporating Insights from the Model into the Policy Process

How might central banks adapt their monetary-policy processes to take account explicitly of the intertemporal tradeoff we have identified? One suggestion is that policymakers should seek to develop summary measures of financial conditions that are most useful for capturing the kind of credit-bites-back risk we have highlighted. Many central banks now produce financial stability reports that track a wide variety of indicators in financial markets, which represents progress relative to the situation before the global financial crisis of 2008–2009. Most of these reports, however, stop short of making an overall judgment about the level of risk to the macroeconomy and its implications, if any, for monetary policy. For instance, the Federal Reserve's biannual Financial Stability Report offers no summary assessment of the level of risk from the areas it reviews.

This approach stands in stark contrast to the treatment of key macroeconomic factors that feature in conventional models. For example, it is hard to imagine a central bank seeking to pursue inflation targeting without a commonly agreed measure of inflation.

Such a lack of consensus as to the nature of the problem can create a situation where, as long as a large number of indicators are not flashing red, the default presumption is that monetary policymakers can simply ignore credit-bites-back effects when they go about setting their target for short-term rates. Such a

default setting may be especially problematic when, as argued by Fontanier (2022), extrapolative behavior on the part of market participants implies that the right time to begin leaning against financial imbalances is relatively early in the cycle—not when these imbalances have reached a critical level and when inadvertently popping a bubble may do considerable harm.

A related challenge is to integrate the analysis of financial risk more fully into monetary policy decision-making. The Federal Reserve currently does deep dives on financial risk four times a year and publishes much of the work in two financial stability reports. The Fed should consider discussing these risks and their implication for policy at every meeting, much as they currently do with inflation, the other major source of tradeoff they face in stabilizing real activity. After all, nobody thinks that the right way to deal with the risk of accelerating inflation is to have a default presumption that it is not a problem until the situation is indisputably critical. Careful ongoing monitoring and a willingness to take early action if needed are core to the policy process for dealing with inflation. The intertemporal tradeoff associated with credit-bites-back risk should be managed analogously.

Ultimately, these changes to the policy process should be reflected in how central banks communicate with the public and the elected representatives to whom they are accountable. For example, the Fed's annual "Statement on Longer-Run Goals and Monetary Policy Strategy" mentions the importance of financial stability as a precursor for achieving its other objectives. This framing could be adjusted to recognize that threats to these objectives can come not just from exogenous developments in financial markets, but also from the Fed's own aggressive attempts to support the economy.[2]

Relatedly, in its annual monetary policy reports to Congress, the Federal Reserve shows five interest-rate rules that are used as points of reference in policy deliberations. None of these rules take account of financial conditions. The Fed may wish to experiment with alternatives that make different judgments about how to weigh the circumstances of the moment against potential constraints on future policy.

Admittedly, the current state of research does not provide decisive guidance on how best to measure credit-bites-back risk. Thus, moving in these directions poses challenges, but our view is that having even an imperfect measure of risk, taken into account in a disciplined way, is better than ignoring the potential tradeoff. Confronting these issues head on and talking publicly about them might also spur Congress to take steps to improve the macroprudential tools that are available to regulators. Any progress on that front would also be highly desirable in its own right.

[2] In fact, since May 2019 the Fed's financial stability report has included the results from a survey it conducts of its private sector contacts regarding the near-term risks to the economy. Participants routinely cite risks emanating from monetary policy as a major source of concern. For instance, in November 2022 it was deemed to be one of the top two short-term risks to the economy.

Exogenous and Endogenous Determinants of the Neutral Real Rate of Interest

A central concept in the conduct of monetary policy is the neutral real rate of interest, often referred to as r^*, which is level of the short-term real interest rate at which output equals potential and policy is neither inflationary nor deflationary. A large body of research has found that r^* declined significantly for the US economy, as well as in several other advanced economies, in the years leading up to the onset of the COVID-19 pandemic in 2020 (for a summary, a useful starting point is Holston, Laubach, and Williams 2017). Common explanations for this decline focus on *exogenous* demographic and technological factors at the global level, such as increased savings by an aging population, a slowdown in trend productivity growth, and increased income inequality (Straub 2019).

More recently, several papers have argued that part of the decline in the neutral rate of interest r^* could instead be *endogenously* related to the prior conduct of monetary policy by means of a hysteresis effect whereby low interest rates beget the need for continued low rates in the future. One mechanism that generates such an effect works through durable goods—for example, if low rates today lead consumers to buy a lot of new cars, there will be less demand for cars going forward, and the policy rate will have to be lower (all else equal) to sustain enough aggregate demand to keep the economy at full employment (McKay and Wieland 2021). Other mechanisms can have similar consequences. For example, a period of low rates encourages mortgage borrowers to refinance, which is stimulative, but which exhausts the pool of future refinancers and hence weakens the power of this channel going forward (Berger et al. 2021; see also Greenwald 2018; Wong 2021; Beraja et al. 2019). In a similar vein, easy monetary policy can cause households to become more highly indebted, which in turn makes further stimulus less effective (Mian, Straub, and Sufi 2021).[3]

Our model offers another reason why there can be history-dependence of this sort in r^*: easy monetary policy creates a boom in asset prices, but then effectively corners policymakers into keeping policy easy for fear of creating an asset-price reversal that damages the economy.

The distinction between the exogenous/demographic/technological and the endogenous/history-dependent accounts of the neutral rate of interest r^* is of practical importance for several reasons. First, if the decline in r^* is driven by outside factors, the job of the central bank is effectively to come up with its best empirical estimate of the current (exogenous) value of r^* and then to set policy rates accordingly. By contrast, if the decline in r^* is at least partially endogenous, there is a looking-in-the-mirror problem: simply knowing that it will take a low policy rate today to maintain full employment is insufficient for making good decisions over time, because this observation muddles together exogenous factors and the history

[3] In a related vein, Acharya and Rajan (2022) and Acharya et al. (2022) emphasize a potentially history-dependent impact of the increases in bank reserves driven by quantitative easing. They observe that as reserves grow, intermediaries create additional short-term deposits and expand credit lines to match the increase in reserves. They argue that the presence of these claims can lock the central bank into needing to keep reserves high in order for the intermediaries to be able to honor these claims.

of past policy choices. In addition, it ignores the likelihood that low interest rates today may have repercussions for the future monetary policy opportunity set.

Second, the exogenous/demographic/technological view suggests that movements in the neutral rate of interest r^* are likely to be highly persistent, given that the underlying driving factors themselves are so slow-moving. Such a view seems to have informed the Fed's framework review of August 2020, which unequivocally endorsed the proposition that r^* would continue to remain low for the foreseeable future, and which adopted a "lower for longer" philosophy—one that arguably proved problematic when inflation began to rise sharply in the following year.[4] By contrast, an endogenous/history-dependent interpretation of the history of r^* would have presumably provided less confidence as to its stability over the coming years.

International Considerations

Our discussion has thus far taken a largely closed-economy perspective. But the observation that monetary policy works by influencing risk premiums also has important international implications. In influential works, Rey (2013) and Miranda-Agrippino and Rey (2020) argue that if monetary-policy-induced changes in risk premiums are highly correlated across countries—as one might expect if the arbitrageurs who police these risk premiums are global financial players—then individual central banks around the world will have less policy independence than is normally envisioned in flexible-exchange-rate, open-economy macro models.

Table 1 illustrates this point, focusing on data from the period January 1998 to December 2021. The left column of the table shows the correlation of one-month changes in one-year yields—a natural proxy for the expected short-term path of monetary policy—between US government bonds and those from six other advanced economies: Australia, Canada, Switzerland, Germany, Great Britain, and Japan. The right column repeats the exercise for ten-year yields, which one can think of as capturing both the expected path of monetary policy, as well as a term premium. As can be seen, in all cases, the correlation of changes in long-term yields is higher than the correlation of changes in short-term yields. In several cases, most notably Australia, Germany, and Great Britain, this differential is strikingly large; for example, the correlation of changes in Australian one-year yields with changes in US one-year yields is 0.42, while for ten-year yields the corresponding correlation is 0.73.

This pattern suggests that term premiums across countries are more tightly correlated than short-term policy rates, which underscores the point raised by Rey (2013) and Miranda-Agrippino and Rey (2020): even if one country's central bank attempts to set its monetary policy in a way that is independent of that in other

[4]In a speech accompanying the revised 2020 Statement on Longer-Run Goals and Monetary Policy Strategy, Chair Jerome Powell (2020) said: "This decline in assessments of the neutral federal funds rate has profound implications for monetary policy. . . . [G]oing forward, employment can run at or above real-time estimates of its maximum level without causing concern, unless accompanied by signs of unwanted increases in inflation or the emergence of other risks that could impede the attainment of our goals."

Table 1

Correlations between One-Month Changes in One-Year and Ten-Year US and Advanced Economy Government Bond Yields

Area (currency)	*Correlation with one-year US Treasury yields*	*Correlation with ten-year US Treasury yields*
Australia (dollar)	0.42	0.73
Canada (dollar)	0.71	0.84
Switzerland (franc)	0.43	0.59
European Union (euro)	0.53	0.73
Great Britain (pound)	0.56	0.77
Japan (yen)	0.18	0.33

Source: For data sources, see Kashyap and Stein (2023).
Notes: The left column shows the correlation of one-month changes in one-year yields between US government bonds and those from, respectively, Australia, Canada, Switzerland, Germany, Great Britain, and Japan. The right column repeats the exercise for ten-year yields. The sample period runs from January 1998 to December 2021.

countries, it may not fully succeed in doing so, particularly if what ultimately matters for economic activity are risk-premium-inclusive financial conditions such as longer-term rates. Moreover, if one believes that the US Federal Reserve has a preeminent role in determining these risk premiums due to the dominant role of the US dollar in international finance, then this mechanism has the potential to increase significantly the Fed's influence over other economies.

Conclusions

Our analysis is built on two well-documented findings: (1) monetary policy operates in significant part by influencing financial-market sentiment; and (2) these sentiment shifts are prone to reversals, which can impair the credit-supply mechanism and ultimately damage the real economy. Taking account of these effects has the potential to overturn some basic presumptions about how monetary policy should be conducted. Perhaps most importantly, the risk of reversals means that optimal policy no longer always completely offsets even pure negative demand shocks. Instead, policy may in some cases need to trade off the benefits of supporting the economy now against the possibility that an unwinding of financial-market sentiment could lead to worse outcomes in the future.

The broad analytics of this tradeoff are relatively straightforward, but the practical implications are not. Addressing the tradeoff raises serious measurement challenges with respect to gauging the credit-bites-back risk. It will also require standard central-bank operating practices and communication policies to be adapted in a variety of ways. We have highlighted a number of areas where further research along these lines would be especially valuable and look forward to seeing this work develop.

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