

**Inflation: Four Questions Requiring Further Research
to Inform Monetary Policy**



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Introduction

I appreciate the opportunity to present closing remarks at the Inflation: Drivers and Dynamics Conference. The views I present will be my own and not necessarily those of the Federal Reserve System or of my colleagues on the Federal Open Market Committee.

Let me start by thanking the organizers at the Federal Reserve Bank of Cleveland and the European Central Bank for putting together such a strong program and the ECB for its hospitality. It has been a very productive two days focused on frontier research on inflation. High inflation has been the major challenge facing many central banks over the past two years. Returning the economy to price stability in a sustainable and timely way has driven monetary policy decisions.

The U.S. Economy

In the U.S., since early last year, the Federal Reserve has been tightening the stance of monetary policy. We have raised the target range of the federal funds rate by 5-1/4 percentage points. We are also reducing the size of the Fed's balance sheet by allowing assets to roll off in a systematic way according to the plan announced in May 2022, which also helps to firm the stance of monetary policy. The tightening of monetary policy has led to a broader tightening in financial conditions. Banks, which play an important part in monetary policy transmission, have been tightening their credit standards, making credit less available to businesses and households. In addition, Treasury yields, mortgage rates, and credit spreads have risen.

The monetary policy actions taken to date are helping to moderate demand in both product and labor markets and to alleviate some of the imbalances that have contributed to price pressures. Real output growth has slowed from its robust pace in 2021. Supply is also adjusting, with disruptions in supply chains having generally improved over time. In the labor market, some progress is being made in bringing demand and supply into better balance, but the job market is still strong. Job growth has slowed and job openings are down, but the unemployment rate is low, at 3.8 percent, and the vacancy-to-

unemployment ratio is still above its level during the strong labor market conditions in 2019. Labor supply conditions are helping to rebalance the labor market; the labor market participation rate of workers between the ages of 25 and 54 is above what it was before the pandemic.

Progress continues to be made on inflation, with total PCE inflation down significantly from its peak. Underlying measures of inflation have also improved but less so. Despite high inflation rates, medium- and longer-term inflation expectations remain reasonably well-anchored in a range consistent with the Fed's goal of 2 percent inflation. Although there has been some progress, inflation remains too high. The FOMC is committed to moving inflation down to 2 percent. The monetary policy questions are whether the current level of the federal funds rate is sufficiently restrictive and how long policy will need to remain restrictive to keep inflation moving down in a sustainable and timely way to our goal of 2 percent. Future policy decisions will be about managing the risks and the intertemporal costs of over-tightening vs. under-tightening monetary policy. This assessment will require close monitoring of economic, banking, and financial market developments and using all of that economic reconnaissance to determine whether the economy is evolving in line with the outlook or not. The outlook will need to be informed not only by the incoming data but also by our models of and understanding of inflation dynamics, which has been the topic of this conference.

Inflation Research

The period of high inflation has highlighted that there are many things we do understand about inflation. In particular, when demand is outpacing supply, in an environment of very accommodative fiscal and monetary policy – the conditions that characterized the economy in 2021 after the pandemic-induced shutdown – inflation will begin to rise and it will remain persistent until monetary policy is recalibrated to moderate demand. Nonetheless, making such assessments in real time is difficult, especially when supply conditions are not stable, and forecasting inflation remains challenging. Indeed, FOMC participants underestimated inflation for much of the high-inflation period. But policymakers are required to make decisions based on the available, albeit limited information.

Further research is needed on many facets of inflation and inflation dynamics. Since I am in a room full of researchers, I want to highlight some of the questions whose answers would help inform monetary policy decisions. I took the same route when I presented keynote remarks at this conference in 2014, and it turns out that several of the questions I asked are still relevant.¹ Don't be too discouraged: Progress has been made in addressing them. But the period of high inflation and structural changes to the economy during the pandemic and its aftermath have presented new questions and different takes on old questions. Further research will be needed to answer these questions, furthering our understanding of inflation as an aid to monetary policymaking.

Research Questions

The **first question** I asked in 2014 remains relevant: How can we best estimate the underlying trend in inflation?

Monetary policymakers are charged with keeping inflation at its longer-run goal and monetary policy affects the economy with long and variable lags. Both factors mean that policymakers need to be able to forecast inflation over the medium and longer run. So they need a method to separate temporary changes from changes that are more persistent. When the economy reopened after the pandemic-induced shutdown, U.S. monetary policymakers attributed much of the increase in inflation to supply shocks that were expected to be transitory, with inflation expected to return to its low pre-pandemic trend. It took some time and repeated under-forecasts of inflation for policymakers to realize that the conditions for high inflation were in place and that aggressive policy action was required. Better understanding of the factors that affect the medium-run inflation trend and ways to separate temporary changes from changes that are more persistent would have helped to avoid the situation.

¹ See Mester (2014).

Separating temporary from more persistent factors is challenging to do in real time, not only because some of the inflation data get revised (including the PCE inflation measure that the Fed targets), but also because measured inflation reflects a combination of factors: idiosyncratic factors, broader but temporary macroeconomic factors, and more persistent movements that affect the underlying inflation trend. One approach to estimating the underlying trend is to remove items that are often the sources of temporary movements in inflation. The traditional core measures of inflation in the U.S. exclude the prices of food and energy because they are thought to be very volatile. Another approach recognizes that other components can show more volatility than food and energy and derives measures that exclude components with the most extreme movements each month. The median and trimmed-mean inflation rates are of this type.² Some papers have shown that these types of measures can help to identify the underlying trend and may outperform measures of core inflation in forecasting total (aka headline) inflation.³

There are also statistical models that try to isolate the trend from the noise and identify the cyclical and acyclical components of core inflation, where the cyclical components are, by definition, those associated with labor market tightness.⁴

The literature has not discerned a best way to isolate the inflation trend; so, in practice, to forecast inflation, policymakers tend to look at all the measures of inflation, data on the real side of the economy, anecdotal reports from community and business contacts, and various models. Many of the forecasting models being used are informed by theoretical models of inflation dynamics.

² The Federal Reserve Bank of Cleveland produces the median and trimmed-mean CPI inflation rate and the median PCE inflation rate. The Federal Reserve Bank of Dallas produces the trimmed-mean PCE inflation rate. The Federal Reserve Bank of Cleveland's Center for Inflation Research produces inflation measures and analyses of inflation and inflation expectations to inform policymakers, researchers, and the general public (<https://www.clevelandfed.org/center-for-inflation-research>).

³ See Bryan and Pike (1991), Bryan and Cecchetti (1993), and Bryan, Cecchetti, and Wiggins (1997) for CPI, and Meyer, Venkatu, and Zaman (2013), Meyer and Zaman (2019), and Smith (2004) for PCE. An exception is Crone, et al. (2013), who find that headline PCE inflation can beat the core measure in predicting future PCE inflation.

⁴ See Stock and Watson (2020) and Zaman (2019).

Which brings me to my **second question**: Can we reconcile the actual pricing behavior of firms with predictions from the New Keynesian model, the workhorse inflation model used by many central bank economists?

In recent years, a considerable amount of research has examined the real-world pricing behavior of firms and incorporated these facts into macroeconomic models.⁵ In fact, several papers presented at the conference explicitly incorporate micro data into macro models.⁶ I view this as a continuation of the desirable approach of ensuring that our macro models are based on sound micro foundations.

The availability of data on individual prices has made advances possible. New surveys are also being used to better understand firms' pricing behavior. For example, a survey conducted by researchers from the Cleveland, Atlanta, and New York Feds found that firms' prices are strongly influenced by their perceptions about demand for their products, a desire to maintain steady profit margins, and their labor costs.⁷ The paper based on the survey, and included in the conference's poster session, estimates that cost-price passthrough at firms was about 60 percent on average, but that there was considerable heterogeneity across the firms. Interestingly, although firms do tend to raise their prices when wages rise, other research from the Cleveland Fed indicates that consumers do not expect their wage growth to keep up with inflation. The researchers find that a 1 percentage point increase in inflation expectations causes expectations of income growth to rise by only two-tenths of a percentage point; in other words, respondents expect rising inflation to hurt their real income. This might help to explain why people dislike high inflation even when the labor market is strong.⁸

⁵ Klenow and Malin (2010) review the literature.

⁶ These papers include Adam, Alexandrov, and Weber (2023), Gagliardone et al. (2023), Lan, Li, and Li (2023), and Sara-Zaror (2021).

⁷ See Dogra, et al. (2023).

⁸ See Hajdini, et al. (2023).

Research such as this can help to close the gap between the macro models we use to inform our monetary policy decisions and the microeconomic data. In addition, research on actual pricing behavior can also inform the framework for setting monetary policy. For example, at first blush it might seem that having a higher inflation target, all else equal, gives monetary policymakers more room to move the nominal interest rate down before hitting the effective lower bound; they could then provide more stimulus to the economy, if needed. But Cleveland Fed research suggests that all else would not be equal.⁹ In particular, a higher inflation target would not provide as much policy room as one might expect; raising the inflation target would be subject to the Lucas critique. With higher steady-state inflation, firms would change their price-setting behavior and adjust their prices more frequently. Because monetary policy's ability to affect real activity depends on the degree of price stickiness, a higher inflation target would make monetary policy less effective because firms would be changing their prices more frequently. The research's quantitative result suggests that to increase policy space by 2 percentage points, instead of increasing the inflation target from 2 percent to 4 percent, one would need to increase the target to 5 percent. If you add to this the costs of having to change posted prices more often, the higher level of relative price distortions because everything is not indexed, higher shoe-leather costs from searching for the lowest prices, and the higher inflation volatility associated with higher inflation, the benefits of setting a higher inflation target are not compelling.

The Fed's inflation target is 2 percent, and we are committed to returning inflation to 2 percent in a sustainable and timely way. This explicit target was first established in the FOMC's statement on longer-run goals and monetary policy strategy in January 2012, and it has been reaffirmed every year since then. The 2 percent target was taken as given when the FOMC undertook its review of the monetary policy framework in 2019. The revised statement on longer-run goals and monetary policy strategy, which reflects the outcome of the review, recognizes the importance of keeping inflation expectations well-

⁹ See L'Huillier and Schoenle (2023).

anchored at levels consistent with 2 percent inflation.¹⁰ And by “well-anchored” I mean longer-term inflation expectations that are insensitive to data.

One of the big lessons from the 1970s is that it is much more difficult and costly to bring inflation down once it has become embedded in the economy, that is, once businesses and households expect inflation to remain elevated and those expectations influence their savings and investment decisions and price-setting and wage-setting behavior. Indeed, inflation expectations have been a central factor in models of inflationary dynamics since the 1960s and 1970s.¹¹ The theory indicates that well-anchored longer-term inflation expectations can help to mitigate the pull of resource gaps on inflation, and therefore, the cyclical movements in interest rates that policymakers induce to maintain price stability need not be as large as when inflation expectations are not well-anchored.

Putting the theory into practice brings me to my **third question**: For the purposes of setting monetary policy, how should inflation expectations be measured and over what time horizon?

One difficulty in moving from theory to practice is that while the models talk about “inflation expectations,” these expectations are not directly observable. So policymakers look at a number of measures that differ by type of agent and time horizon. These include measures based on surveys of consumers, businesses, and professional forecasters; measures derived from financial markets; and composite indices that combine various measures. A clear signal is not always forthcoming because the inflation expectations of different groups of agents can behave differently from one another. Even within

¹⁰ The FOMC’s statement on longer-run goals and monetary policy strategy, revised in 2020 and reaffirmed since then, says that the Committee judges that longer-term inflation expectations that are well-anchored at 2 percent contribute to achieving its monetary policy goals. See Federal Open Market Committee (2023).

¹¹ See Phelps (1967), Friedman (1968), and Lucas (1972). For further discussion see Mester (2022a,b).

groups there can be variation, and the literature has not firmly established whose expectations are most important for inflation dynamics.¹²

Households may find it challenging to answer questions about the economic concept of inflation. Recent Cleveland Fed research found that when consumers are asked about what they think inflation will be in the future for the various categories of consumer spending, their answers do not aggregate up using any plausible weighting scheme to what they expect overall inflation will be.¹³ Aggregated inflation expectations over categories tend to be lower than expectations of overall inflation, and the bottom-up aggregated expectations explain a greater share of planned consumer spending. This inconsistency reinforces the approach taken by policymakers to look at various measures of inflation expectations.

Indeed, several new measures are increasing our understanding of inflation expectations. Researchers at the Cleveland Fed have developed a measure of inflation expectations that does not require the respondents to understand the economic concept of aggregate inflation. The Cleveland Fed's indirect consumer inflation expectations (ICIE) measure, which started in 2021, is based on a nationwide survey with more than 10,000 responses and is updated on a weekly basis. Instead of asking consumers directly about overall inflation, the survey asks consumers how they expect the prices of the things they buy to change over the next 12 months and how much their incomes would have to change for them to be able to afford the same consumption basket and be equally well-off.¹⁴ According to this measure, women's inflation expectations have tended to run higher than those of men, and older respondents and more educated respondents also have reported higher inflation expectations than their counterparts.

¹² Candia, Coibion, and Gorodnichenko (2021) find that the mean inflation forecasts of firms often deviate significantly from those of professional forecasters and households.

¹³ See Dietrich, et al. (2022).

¹⁴ The ICIE series is available on the Central Bank Research Association (CEBRA) website at <https://cebra.org/indirect-consumer-inflation-expectations/>. For background on the survey and results using the survey, see Hajdini, et al. (2022a,b).

Less information has been available on firms' inflation expectations, even though firms are the price setters. But new data series are being developed. For example, the Cleveland Fed has begun publishing the Survey of Firms' Inflation Expectations (SoFIE), a nationally representative, quarterly survey of CEOs and other top business executives, which was started by academics in 2018.¹⁵ The survey data indicate that the year-ahead inflation expectations of these business executives rose as inflation increased in 2021 and 2022. Their expectations began to decline in 2023 but remain elevated at 4.3 percent as of July. Perhaps more troubling is that when respondents were asked in April what they thought the Fed's inflation target was, the mean response was 3.1 percent. This is higher than our target of 2 percent and also nearly a percentage point above the mean response before the pandemic.

Monetary policymakers typically focus on medium- to longer-term inflation expectations because this is the time horizon over which monetary policy can be expected to affect the economy and is more reflective of consumers' perceptions of the Fed's commitment and ability to return the economy to price stability. Ample research shows that changes in the prices of particular salient items, including gasoline and food, which are independent of monetary policy, can have an outsized effect on households' shorter-run inflation expectations.¹⁶ However, recent research by Cleveland Fed economists indicates that policymakers should not ignore persistently elevated levels of shorter-term inflation expectations and focus only on longer-term expectations. The researchers find persistent differences in inflation expectations across consumers of different ages and that households form their expectations of inflation based on their lifetime experience of inflation.¹⁷ When this mechanism is incorporated into a conventional New Keynesian model, inflation shocks are more persistent than otherwise, and the optimal response is for monetary policy to tighten when short-run inflation expectations rise even if longer-run

¹⁵ The Survey of Firms' Inflation Expectations (SoFIE) was created by Professors Olivier Coibion and Yuriy Gorodnichenko; it is maintained by the Federal Reserve Bank of Cleveland at <https://www.clevelandfed.org/indicators-and-data/survey-of-firms-inflation-expectations>. For background on the survey, see Garciga et al. (2023).

¹⁶ For the effect of salient prices on inflation expectations, see Coibion and Gorodnichenko (2015), Cavallo, Cruces, and Perez-Truglia (2017), D'Acunto, et al. (2021), and Campos, McMain, and Pedemonte (2022).

¹⁷ See Pedemonte, Toma, and Verdugo (2023).

expectations are stable. Doing so helps to limit the experience households have with high inflation, which helps to keep inflation expectations anchored in the future.

Better understanding of how households and firms form their inflation expectations will help inform how monetary policymakers should respond when inflation deviates from the target. This brings me to my **fourth and final question**: How should monetary policymakers respond to supply shocks?

The current episode of high inflation has been a challenging one. In the U.S., inflation began rising in the spring of 2021. A sequence of supply shocks, driven first by the pandemic and then the war in Ukraine contributed to the high inflation. These supply shocks were concentrated in the goods sector, which was already seeing a surge in demand as consumers shifted spending from services to goods during the pandemic-induced shutdown and when they continued to take social distancing measures once the economy reopened. The supply shocks exacerbated the imbalances between demand and supply, which, in an environment of very accommodative fiscal and monetary policy, led to a significant and persistent increase in inflation.

The episode has called into question the conventional view that monetary policy should always look through supply shocks. The thinking is that supply shocks tend to be transitory, and while they raise the price level for a time, they do not lead to a persistent increase in inflation or inflation expectations. Moreover, since monetary policy acts with a lag, if policymakers were to react to a transitory supply shock, it would be counterproductive, affecting the economy after the supply shock had dissipated. But to the extent that supply shocks are more persistent or there is a sequence of supply shocks, this thinking need not apply because such shocks can threaten the stability of inflation expectations and this would require policy action. Indeed, when inflation expectations are not firmly anchored, if monetary policy

fails to react in an appropriate way, what starts out as a potentially temporary shock could lead to more persistent effects on inflation.¹⁸

This brings up the possibility that monetary policy may want to react differently depending on the nature of the shock that has led to a rise in inflation, with the reaction dependent on the size and persistence of the shock, because different shocks have different implications for inflation expectations. An interesting paper presented at the conference suggests that in an environment where prices are more flexible than wages and agents have bounded rationality rather than fully rational expectations with respect to inflation, policy may want to respond more aggressively to supply shocks when inflation is already high and less aggressively when inflation is low.¹⁹ This can lead policymakers to first look through supply shocks and then respond more aggressively as inflation moves up, which arguably characterizes the current high-inflation episode. However, other interesting research shows that optimal monetary policy responses depend critically on how inflation expectations are formed and how well they are anchored. In one model, when expectations differ from rational expectations and are not well-anchored, policymakers are better off responding earlier to signs that inflation is rising rather than delaying and only then responding aggressively.²⁰ The implication is that when there is uncertainty, policymakers should overestimate the degree of persistence of inflation shocks rather than underestimate it.

More research on the timing and magnitude of the optimal monetary policy response in the face of different types of shocks and when inflation expectations deviate from rational expectations would be helpful to policymakers.

¹⁸ Reis (2021) and Walsh (2022) discuss the importance of anchored inflation expectations, drawing on the experience of the U.S. during the 1960s and 1970s.

¹⁹ See Beaudry, Carter, and Lahiri (2022).

²⁰ See Walsh (2022)

Conclusion

To conclude, let me again thank the organizers at the European Central Bank and at the Cleveland Fed for putting together such a strong conference program. When we started the Cleveland Fed's Center for Inflation Research in December 2018, some people raised an eyebrow. They questioned the center's focus because inflation had been so benign for quite some time. It turned out to be precisely the right time to further the research agenda on inflation. Maintaining price stability is the responsibility of the central bank and only the central bank can deliver on this goal over time. While considerable progress has been made on developing inflation models and measures that can better inform monetary policymaking, we still have much to learn about inflation dynamics. I encourage the researchers participating in this conference to continue furthering their research agendas because good policymaking depends on the research that informs it.

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