

# Why did inflation rise and fall in 2021-24? Channels and evidence from expectations\*

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## **Abstract**

This article uses inflation expectations to investigate the mechanisms that linked supply and demand shocks to inflation outcomes during 2021-24. It describes multiple theoretical channels where expectations play a central role; it judges if they were active using multiple sources of expectations data for the US, EA, and UK; and it surveys the literature that has tried to isolate their contribution during the inflation surge. The article applies the results from this investigation to assess how well anchored inflation expectations were during the inflation surge and at the end of it.

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# 1 Introduction

The increase in the US price level between the start of 2021 and the end of 2024 exceeded the Federal Reserve’s inflation target by a full 10 percentage points. Why did this happen?

**The conventional account.** By August of 2024, a conventional account had emerged, expertly laid out by the Fed chairman in his annual Jackson Hole speech (Powell, 2024): At the start of 2021, aggregate demand expanded quickly, as consumers rushed to spend the pent-up savings from the pandemic and government spending stimulated the economy. Since aggregate supply was restricted by a slow-to-recover labor supply and difficult re-allocation of resources across sectors, inflation rose. Towards the end of that year and the start of 2022, two further shocks hit that added further momentum to the rise in prices: an increase in energy prices following Russia’s invasion of Ukraine, and bottlenecks in global supply chains resulting from lockdowns in different parts of the world. A third and final shock came from monetary policy hiking interest rates during 2022. This contractionary shock, working with a lag, together with the unwinding of the previous two shocks, made inflation come down quickly between mid-2022 and mid-2023, and slowly but steadily thereafter.<sup>1</sup>

Accounts for EA and UK inflation are similar, although with a higher weight on the energy shocks in the second stage, and a lower weight on post-pandemic private and public consumption spending in the first stage (Lane, 2024, Tenreyro, 2023). Knowing what they know today, many policymakers state they would have tightened monetary policy earlier.<sup>2</sup> But such large shocks all pushing in the same direction were hard to anticipate or even to measure and to understand in real time.<sup>3</sup>

**From shocks to mechanisms.** This is a *shock account* of an economic event. It comes naturally within an economic model, which will decompose the movements in an endogenous variable like inflation into the contribution of exogenous shocks, like the pandemic, fiscal expansion, or monetary surprises. It allows us to ask what the world would have looked like without these shocks.

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<sup>1</sup>Econometric support for this narrative is in Dao et al. (2024), Bernanke and Blanchard (2025), and Lipinska, Garcia and Schwartzman (2025).

<sup>2</sup>Lane (2024): “If policymakers had had perfect foresight about the shocks that were about to hit the economy, interest rates would have been raised earlier and more sharply.”

<sup>3</sup>Lane (2024): “Two once-in-a-generation shocks of extreme virulence have hit the economy in a space of less than three years: first the pandemic, and its various aftershocks; and then the war in Ukraine, and its effect on energy and other commodity prices.”

But, from the perspective of policy, it is arguably more important to ask how these same shocks would have led to different outcomes if policy rules and institutions had been different. Policymakers can do little to prevent shocks, but what they can do is consider different responses to these shocks and pick the best.

In turn, scientists want to use the 2021-24 data to figure out how economies work. That requires identifying the mechanisms through which any shock transmits into an observed outcome, rather than just this particular and likely not-to-be-seen-again combination of shocks. The answer to “why did this happen?” requires not just shocks but especially mechanisms.

More pragmatically, both academics and policymakers should be able to bring to the debate suggestions on how to prevent a similar inflation disaster from happening again. The conventional shock account offers none since we cannot prevent future shocks. Instead, if one figures out the mechanisms, one can suggest a combination of reforms and policy responses.

A fit illustration of the importance of looking at mechanisms comes from Giannone and Primiceri (2024)’s analysis of this inflation episode. How much inflation rises from adverse supply shocks depends on how monetary policy is conducted, and on how it is perceived to be conducted by private agents. In the two decades before the inflation surge, policy had credibly kept inflation near its 2% target by quickly and decisively offsetting any shock. As agents believed it would always be so, they started adjusting quantities as opposed to prices in response to shocks. In an AS-AD framework, the AD had become flat by 2020.

Therefore, as large as the supply shocks might have been shifting the AS curve, a large increase in inflation could only happen if there was a very deep recession. This is not what we saw. Instead, for the supply-shock account to be correct, the AD in 2021-22 must have been quite steep (or, almost indistinguishably, it must have shifted). Either monetary and fiscal policy changed relative to the previous decades, or people’s expectations of it changed, or both. Supply shocks may have caused the inflation surge but it was demand policies and expectations that allowed it to happen. A similar point applies with respect to fiscal shocks: Hazell and Hobbler (2025) find that the US fiscal deficit *shock* of 2021 caused some of the rise in inflation through the *mechanism* of no reaction of policy rates to it, as shown by the *evidence* from expected inflation in market swap prices.

Therefore, the conventional account of listing the supply shocks as the causes of the inflation surge hides the more interesting and important question: why did policy behave

differently, or/and why did people's expectations change so brusquely following these shocks?

**The importance of expectations data: forecasting.** Examining all of the mechanisms linking shocks to inflation outcomes is too much for a single article. This paper has a more targeted (and yet perhaps still too ambitious) goal. It will look at the evolution of the *data on inflation expectations* during this time to uncover some of the mechanisms from shocks to inflation.

There are three reasons why these data are particularly informative.

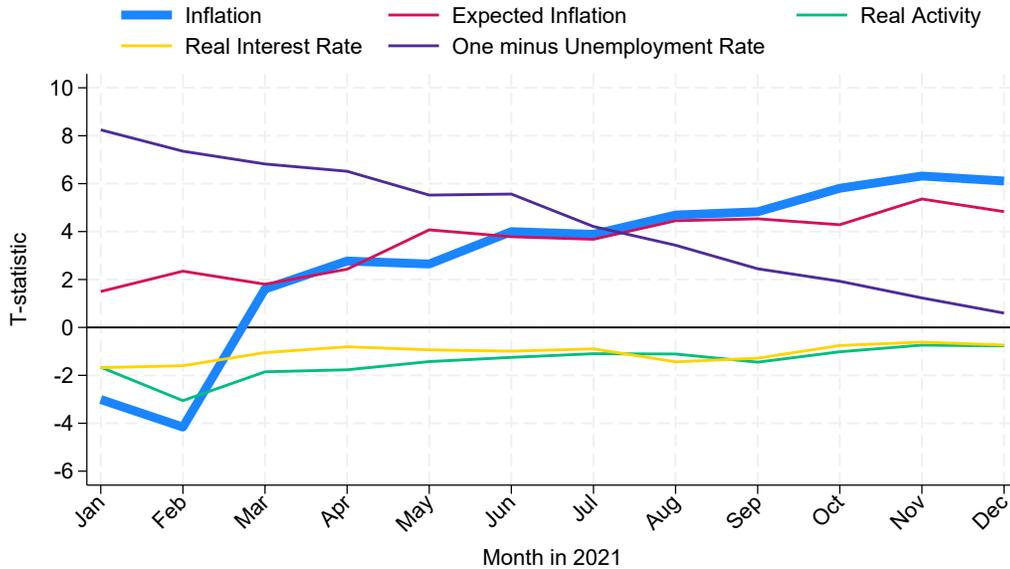
The first is perhaps the shallowest, but also the most pressing: expectations data stood out in 2021. Across broad sets of indicators, they were the ones that earlier and more decisively signaled that an inflation disaster was under way in 2021. Figure 1 shows this information value of expectations in a simple way. It takes a representative variable from each of the four groups of variables most used to forecast inflation: real activity, the labor market, financial markets, and expected inflation. It plots the difference between the value of that variable in each of the twelve months of 2021 and its value in January of 2020. It expresses that difference in standardized units, using the variability of changes in that variable in the decade before the pandemic. If the changes in these variables were normally independently distributed over time, these would be t-statistics to judge whether the observed evolution of the variable was unusual relative to the decade before.

By at least April of 2021, inflation was unusually higher. It became ever more so in the eight months that followed.

During this time, the real activity and financial variables raised no alarm bells. The labor market variable was unusual at the start, but on the wrong side, as a loose labor market usually indicates low inflation, and it went back to normal as the year went by. Expected inflation was the one indicator pointing to the disaster right from the start. Moreover, the inflation indicator variable in the figure is available with a one-month delay, and is successively revised one and two months later. Expected inflation instead is released at the end of each month. The coincidence between the two variables in the figure reflects expected inflation being a leading indicator of actual inflation by 1-3 months during this unusual year.

**The importance of expectations data: theory and policy.** The second reason to look at expectations data is grounded in economic theory. Modern macroeconomics emphasizes intertemporal tradeoffs and decisions, so there are few relevant economic mechanisms

**Figure 1:** Expectations were the leading indicator of the inflation surge



Note: The four indicators are: industrial production for real activity, one minus the unemployment rate for the labor market, the 10-year Treasury rate for financial markets, and the mean answer in the 1-year ahead Michigan survey for expected inflation. For indicator  $x$  at each date  $t$  this figure shows the variable  $(x_t - x_{01-20})/\sigma(\Delta^t x)$  where  $\Delta^t x$  is the difference between the monthly value of the variable and its value as-many-months earlier as the distance between  $t$  and January of 2020, and  $\sigma(\cdot)$  is the sample standard deviation of these changes between January of 2010 and December of 2019. For industrial production, the only variable of the five that has a clear trend, I also subtract the sample average of  $\Delta^t x$  in the numerator.

that do not involve expectations of the future. At an elementary level, if people expect high inflation in the near future, they do not want to hold nominal assets that will quickly lose their value, and whether by trying to exchange them for real assets or by using them to pay for goods, this will contribute to raising inflation now. There are few (if any) accounts of how demand or supply shocks raise inflation as they did in 2021 that does not involve describing what happened to expectations.

Moreover, how policy shapes these expectations is an important lever for controlling inflation. Inflation, at its heart, is the change in the real value of the liabilities of the central bank. Affecting how private agents expect this real value to change is an integral part of what central banks can do (Castillo-Martinez and Reis, 2025). A common policy principle states that, following a temporary shock, as long as inflation expectations remain anchored, then the impact of the shock on inflation will always be temporary (Powell,

2024). A simple evaluation of the performance of monetary policy during 2021-24 is to measure to what extent it kept expectations anchored. In the extreme case of hyperinflation, both theory and history have shown that people expecting ever-increasing inflation becomes the main driver of inflation, and that only credible reforms to fiscal and monetary policies that bring those expectations under control can bring down inflation.

**The importance of expectations data: research advances.** The third reason to look at expectations is that their scientific study has gone through an empirical revolution in the last 20 years (Reis, 2024, Gorodnichenko, 2025). Researchers have started jointly exploiting the information in the cross-sectional and time-series variability in survey data, as well as the high frequency and microstructure of financial prices from market data. The available data has multiplied, as new surveys were conducted and granular regulatory data on financial holdings were made available. Causal inference has made large strides, by using randomized control strategies, cross-regional variability in monetary unions, impulse responses to identified shocks, and high-frequency event studies. This trove of research guides us in what to look for in the data to figure out the mechanisms of inflation dynamics during this period.

**What this paper will do.** Each section in this paper uses a different type of expectations data for the US, EA, and UK to clarify the mechanisms and the role of policy in the inflation surge of 2021-24. In each of the sections, I start by sketching the theory behind the mechanisms and then present some original empirical work. Along the way, I discuss the findings of the literature that looked directly at particular features of inflation expectations during this period. I find that the expectations data indeed speak quite decisively about which mechanisms transmitted the shocks to inflation. I conclude each section by asking whether inflation expectations were anchored during 2021-24, and whether they are anchored now. Unsurprisingly, that answer is invariably: “it depends”, but hopefully what it depends on will be useful.

Section 2 starts with inflation expectations for long horizons provided by financial markets. These are particularly useful to test Fisherian (or monetarist) mechanisms that emphasize the credibility of the central bank’s inflation target. Surveys of professionals working in financial institutions complement them. Section 3 turns to survey data from households and firms at 1-year horizons, with which to test Phillips curve channels that rely on the pricing behavior of workers and firms. Section 4 then uses the expectations from institutional forecasts to look for the extent to which the inflation surge was fiscally-

driven. Finally, section 5 uses the expectations of policymakers to reveal their preferences and justify their actions. Section 6 concludes and relates the findings to those of two other articles written at the same time as this that asked similar questions (Coibion and Gorodnichenko, 2025, Hajdini et al., 2025).<sup>4</sup>

## 2 Market expectations

Banks have the privilege of holding deposits at the central bank. Those deposits define the unit of account in a digital economy, so that inflation—being the loss of real value of that unit of account—is linked to the willingness of banks to hold these deposits as opposed to investments in the real economy. Banks form their expectations within financial markets, partly by looking at market prices and partly by listening to financial professionals that forecast the future. This section starts our investigation by looking at these data and linking it to crucial mechanisms through which shocks transmit to outcomes.

### 2.1 Theory: monetarist/Fisherian mechanisms

When banks choose to hold deposits at the central bank, they compare the nominal return that they get on this digital money to the alternative real investments. These earn the real interest rate  $r_t$  plus the market risk-neutral expectation  $\mathbb{E}_t^m(\cdot)$  of inflation during the 1-period duration of this investment  $\pi_{t+1}$ . At the same time, the behavior of the central bank in setting or steering nominal interest rates is approximately equal to their estimate of that real rate  $\hat{r}_t$  plus their inflation target  $\pi^*$  and a Taylor-reaction term whereby inflation above target leads to a tightening policy by raising nominal rates by  $\phi$ . Therefore:

$$r_t + \mathbb{E}_t^m(\pi_{t+1}) = \hat{r}_t + \pi^* + \phi(\pi_t - \pi^*). \quad (1)$$

This is an arbitrage condition. It captures a powerful economic mechanism that is present in any monetary macro model where the Fisher condition holds. Say that, after a shock, banks expect inflation to be higher on the left-hand side. Then, they will want to withdraw their deposits at the central bank, and instead lend or invest in the real economy. As they do so, the relative value of those deposits must fall. Since the change in that

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<sup>4</sup>A related literature asked whether inflation expectations were anchored after large changes in monetary policy (Kumar et al., 2015, Bonomo et al., 2024) and during the 1970s inflation disaster (Reis, 2021).

value is, by definition, what inflation is, then the shock raises inflation via the increase in expected inflation.

Complementary, say that the shock is not to expected inflation directly, but rather to raise the real interest rate on the left-hand side. If inflation expectations are tightly anchored in the sense that expected inflation barely rises, then, from the right-hand side of the equation, the increase in inflation is lower than it would have been otherwise. The insensitivity of expectations to shocks reduces the amplification of the shock because banks keep their desire to hold central bank money unchanged.

Finally, take as given instead an increase in inflation today after some shock. Then, from the right-hand side to the left-hand side, expected inflation tomorrow rises by  $\phi$ . The aggressiveness of policy in controlling inflation maps into how strongly expectations propagate the deviation of inflation from target.

This difference equation can be written in integral form as:

$$\pi_t = \pi^* + \sum_{j=0}^T \phi^{j-1} \bar{\mathbb{E}}_{t,t+j-1}^m (r_{t+j} - \hat{r}_{t+j}) + \phi^{-T} \bar{\mathbb{E}}_{t,T-1}^m (\pi_{t+T} - \pi^*), \quad (2)$$

where  $\bar{\mathbb{E}}_{t,t+j-1}^m = \mathbb{E}_t^m [\mathbb{E}_{t+1}^m [\dots \mathbb{E}_{t+j-1}^m (\cdot)]]$ . Inflation on the left-hand side depends on the three additive determinants on the right-hand side. The first is the inflation target. The second are misjudgments about the state of the economy captured in a simple sufficient statistic: if the central bank expects the economy to be cooler than it is, in the sense of anticipating a lower equilibrium real interest rate, then inflation will be high. This is the Wicksellian emphasis that justifies trying to figure out the neutral, or starred, interest rate.

The third term is the credibility of monetary policy. If the markets expect inflation to be persistently above the announced target in the future, then they will be unwilling to hold nominal assets, which pushes up inflation to be above target in the present. Inflation expectations appear in this last term. This simple theory, which is present in virtually all DSGE models with nominal interest rates, makes crystal clear that market expectations are the relevant ones for this Fisherian-monetarist market arbitrage channel. More precisely, it is the expectations: (i) of the marginal market participant, (ii) in risk-neutral space so including distributions of risk and (iii) at a long horizon.

Beyond their direct relevance, market inflation expectations have two further virtues. First, market participants can distinguish between a 3-year, a 5-year and a 10-year horizon. Second, these professionals put serious effort into considering the probabilities of remote events. There is no convincing sign that households or firms answering surveys

are able or willing to do either of these.

## 2.2 The basic data: long-run swaps and indexed bonds

There are two main market prices from which to extract a measure of expected inflation at long horizons. The first are the yields on government bonds that have returns indexed to realized inflation. The TIPS in the US and the linkers in the UK are well known for being large, quite liquid, and having long samples. Subtracting these yields from the yields on nominal government bonds of the same duration gives a measure of risk-neutral expected inflation at the desired horizons, sometimes called the breakeven rate.

The second market price is on an inflation swap contract sold by a dealer to one of their clients. The swap pays the realized inflation rate to its holder during the duration of the contract, who in turn pays a fixed amount at a pre-agreed rate. This pre-agreed rate is then a direct measure of expected inflation. Because no cash flows are exchanged when the contract is originated, and payments are made daily to maintain the contract with zero net present value, this is an attractive alternative to holding bonds.

Figure 2 shows the 10-year (10y) US expected inflation from swap markets. Focusing on the long-run justifies trying to take out the earlier years in these 10-year averages. This can be easily achieved by subtracting the 5-year measure from the 10-year measure, which gives the 5-year-5-year (5y5y) expected inflation, that is starting 5 years from now, on average over the succeeding years. The 5y5y measure in the figure comes from indexed bonds.

Both measures rose in 2021, and since 2022 stayed roughly the same, above what they were in 2015-19. The Fisher mechanism suggests that this contributed to some of the rise in inflation in 2022, and some of why it has remained above 2% until the present (2025). At the same time, this contributed to less than 1 percentage point of the increase in inflation.

Throughout the whole sample, the 10y is always above the 5y5y, consistent with equation (2) and  $\phi > 1$ . Interestingly, the large gap that emerged between the 10y and the 5y5y, and the way it partially closed once inflation started falling, suggests that the inflation surge was right away perceived as being temporary.

## 2.3 Research advances on market measures

A problem with both measures in figure 2 is the presence of liquidity frictions that make the market price deviate from actual expectations. For instance, both sides of a trade

**Figure 2:** Market expected US inflation from swaps (10-year) and indexed bonds (5y5y)



Notes: The sample goes from the 1st of January 2015 to the 10th of October 2025 at a daily frequency. Data from Bloomberg (USSWIT10) and FRED (T5YIFR).

may be convinced that inflation will be 2%, but because of regulatory and other limits on the size of the dealer's balance sheet, it would only be willing to carry the contract in its books if the price was higher than that. Researchers would erroneously infer that expected inflation was above 2%.

Focusing on measures of expected inflation from inflation indexed bonds, Gürkaynak, Sack and Wright (2010) argued that these liquidity distortions could be large, which was confirmed by D'Amico, Kim and Wei (2018) using a term-structure model, while Pflueger and Viceira (2016) measured them using a series of proxies for liquidity variables (e.g., off-the-run spreads). More recently, Bahaj et al. (2025) documented that the inflation swap market is sharply segmented across horizons, with hedge funds mostly trading short horizons, pension funds trading at long horizons, and bank dealers being present in both market segments. This structure provides identification strategies that use both prices and quantities traded of swaps to precisely estimate the liquidity frictions.

Figure 3 shows their preferred 10y UK expected inflation cleaned from liquidity frictions just before and during the inflation disaster. To make sense of the values in the vertical axis, note that inflation swaps in the UK are written against the retail price index,

as opposed to the consumer price index that is the reference to the 2% inflation target. In the two decades between 1999 and 2018, the average difference between the two was 0.8pp. Furthermore, recall that this expected inflation measure includes an inflation risk premium. Therefore, while the values around 3.5% in 2019 in the figure are above the inflation target, they are not so by much.

The figure highlights five major events during the sample: two monetary in blue and three others in grey. The first of these is the pandemic lockdown in March of 2020. This came with a sharp and persistent fall in expected inflation. By early 2021 though, markets expected long-run inflation to be back on track. As inflation accelerated, they revised their views upwards, such that by November of 2021, those inflation expectations were 40-50bps above what they were in 2019.

The next event is the Bank of England raising interest rates by 15bp in December of 2021. This had an immediate impact on the credibility of the inflation target, with expectations falling by 15-25bps.

Russia's invasion of Ukraine—the third event—coincided with expected inflation shooting up again, exceeding its 2019 values by more than 75bps by February of 2022.

As the Bank of England raised rates throughout 2022, expected inflation came down, going below 3.5% just as the Bank strongly asserted its commitment to the inflation target with a 50bp hike in August, followed by another 50 in September and 75bp in December. This is our fourth event.

The final event occurred between 5 September and 24 October of 2022. This was the premiership of Liz Truss, where threats to the independence of the Bank of England, announcements of large public deficits, and a short-lived financial crisis came with great volatility of expected inflation. By the start of 2023, UK expected inflation was back at the levels of 2019.

According to this series and description of events, long-run expected inflation moved around with shocks during this time. In turn, so did actual inflation. This is suggestive evidence that the theoretical mechanism described in this section was present. Monetary policy was unable to fully anchor long-run expectations, and market forces amplified the impact of shocks on inflation.

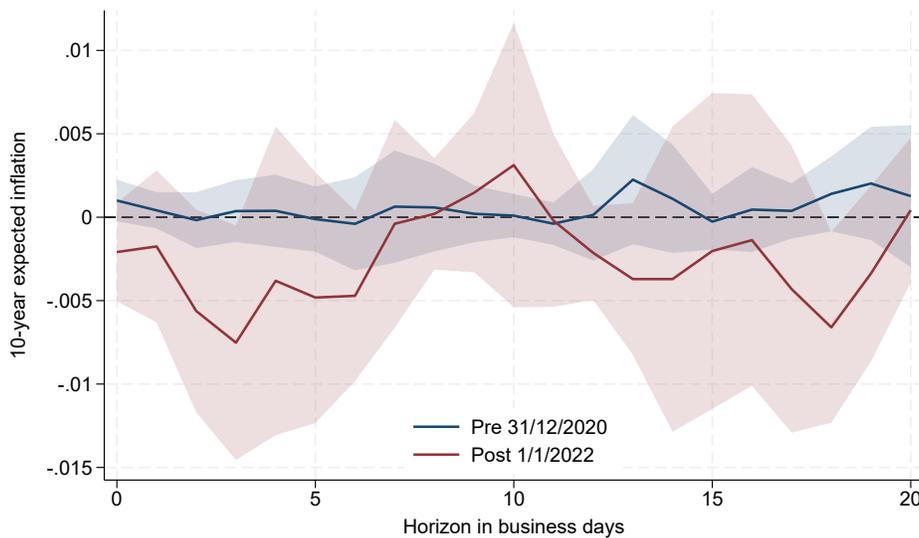
The bottom figure inspects the reverse direction of causality. It shows the impulse response of the series for expected inflation in the top figure following an inflation shock constructed by Ding (2025). The inflation shock is a movement in short-horizon inflation swap prices in narrow windows around the monthly release of inflation data. The figure

**Figure 3:** Market expected UK inflation 10-years ahead against events and shocks

**(a) Value cleaned from liquidity frictions**



**(b) Responsiveness to 1-year expected inflation news around CPI release dates**



Note: The top figure shows the Bahaj et al. (2025) series for 10-year expected inflation from UK swaps cleaned of liquidity frictions. The two monetary policy events, in blue, are the start of hiking in policy rates, and the move to 50bps hikes. The three other events, in grey, are the pandemic lockdown, Russia's invasion of Ukraine, and the period from Liz Truss's mini-budget to the end of her premiership. The bottom figure shows local projections of the series in the top figure on the change in the principal component of 1, 2 and 3-year inflation swap prices in a narrow window around monthly RPI data releases built by Ding (2025).

shows estimates of this response in the period before inflation took off, and in the period after it reached its height.<sup>5</sup>

According to the estimates, following a shock that moves inflation in the present, and so expected inflation in the coming months, the long-run expected inflation does not move in either a quantitative or statistically significant way. This suggests that the movements in long-run expected inflation were not simply driven by the changes in inflation. Yet, Cieslak, McMahon and Pang (2024) and Kroner (2025) find the opposite for the US. The former find that market term premia became more sensitive to inflation shocks in the 2020-23 period, while the latter found that all asset prices become more sensitive to inflation news in 2021-23.

## 2.4 Beyond averages: option contracts and tail risk

At a 5y5y horizon, it is plausible that the median expected forecast of financial market participants is the inflation target of the central bank. It is more likely that what moves the average expectation reflected in figure 2 are either the probability that this inflation target is abandoned or the probability of another inflation (or deflation) disaster. The more informative data would be on the tails of the perceived stationary distribution of inflation outcomes.

Hilscher, Raviv and Reis (2025) present and discuss the market for options over the inflation swap contracts. While this market is not as large or deep as that for swaps themselves, the trading volume is large enough that looking at the trends in the option prices over months is informative. Hilscher, Raviv and Reis (2025) develop methods to convert these prices into probabilities that inflation will be in the tails and regularly update these. Table 1 uses their estimates to assess the extent of the inflation disaster and its scars for the future.

The top panel in the figure starts by showing inflation in the US and the EA in the 5-year period between December of 2019 and December of 2024. This appends the pandemic year of low inflation to the four years of the inflation surge. Still, average annual inflation was 4.2% in the US, and 3.8% in the EA, well above the 2% inflation target. Using option prices on 5-year inflation, the table then shows the probability that inflation would have been this high or higher according to the price of options traded in December of 2019. It presents both the risk-neutral probability, as well as a subjective probability

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<sup>5</sup>See also Bundick, Smith and der Meer (2025).

adjusted for risk premia at the tails. These probabilities were exceedingly small: between 0.3 and 0.9%. The markets did not see the inflation disaster coming.<sup>6</sup>

**Table 1:** Tail probabilities for US and EA inflation from option prices

	United States	Euro Area
<i>How extraordinary was the 2020-2024 inflation?</i>		
Actual realized inflation (in %)	4.19	3.80
Q-Probability in Dec 2019 (in %)	0.46	0.93
P-Probability in Dec 2019 (in %)	0.31	0.61
<i>Probability of 5y5y inflation above 4% (in %)</i>		
December 2019	0.95	1.40
December 2020	2.14	1.14
December 2021	5.14	0.83
December 2022	3.29	4.71
December 2023	4.83	5.85
December 2024	3.72	2.50

Note: The first panel shows realized inflation between December 19 and December 24, together with the December 2019 probability that inflation would have been this value or higher. The second panel shows the annual evolution of the 5y5y probability that inflation will on average be higher than 4%. Data from <https://r2rsquaredlse.github.io/web-inflationdisasters/>.

The bottom panel instead looks at the 5y5y horizon and shows the probability that we will have a similar inflation disaster in the future, understood as inflation being on average 4% or higher during 5 years. In 2019, these probabilities were 1.0 and 1.4% for the US and the EA, respectively. By the end of 2024, they had climbed up to 3.7 and 2.5%, respectively. Participants in financial markets are willing to spend money today to buy insurance against a similar inflation surge occurring again in 2030-35. The inflation disaster left scars.

<sup>6</sup>Blanco, Ottonello and Ranošová (2025) had found before, by studying surveys of professional forecasters in many episodes of inflation surges across decades and countries, that these disasters always come as large surprises. The 2021-24 episode showed this is also true when there is money in contracts at stake.

## 2.5 Disagreement among market participants

A market price reveals the beliefs of the marginal trader, who is just indifferent between buying or selling the security at that price. Who this person is can change over time in a world where people disagree and their willingness to participate in these markets changes. If the distribution of the expectations across market participants is tightly concentrated around the inflation target, then the market expected inflation will not change by much as a result. Examining the spread of this distribution provides a fuller picture of whether inflation expectations are anchored and whether they amplified and propagated the shocks to inflation.

A rich literature has used surveys of professional forecasters to measure the distribution of expectations of these market participants (Aruoba, 2024). These surveys are usually dominated by employees of financial institutions, and while they are rarely the ones making the final investment decisions, they are an input shaping the beliefs of those who do. The initial wave of this literature looked at the unconditional distribution of expectations (Mankiw, Reis and Wolfers, 2004), while a second wave looked at how individual expectations respond to shocks (Coibion and Gorodnichenko, 2015, Bordalo et al., 2020). More recently, research focussed on combining the expectations of inflation and interest rates to recover the monetary policy rule that is perceived by these agents (Carvalho and Nechio, 2014, Bauer, Pflueger and Sunderam, 2024).

To supplement these results, I provide here some additional original evidence. Using the Philadelphia Fed's and the ECB's respective surveys of professional forecasters, I estimate the following regression:

$$\mathbb{E}_{i,t}(\bar{\pi}_T) - \mathbb{E}_{i,t-h}(\bar{\pi}_{T-h}) = \beta(\pi_t - \mathbb{E}_{i,t-h}(\pi_t)) + \phi_i + \eta_h + \chi_h + error_{i,t,h}. \quad (3)$$

Forecasters are indexed by  $i$ , quarters by  $t$ , and the horizon of updating of the forecast by  $h$ . On the left-hand side is the change in the long-run expectations of inflation between this survey wave and the one  $h$  quarters ago. On the right-hand side is the forecast error in short-horizon inflation that this forecaster made between back then and now. If long-run expectations were fully anchored, then  $\beta = 0$ : unexpected inflation over a few quarters should lead to no change in the forecast of inflation in the long run. If instead  $\beta > 0$ , then unexpectedly recent high inflation leads forecasters to revise upwards their long-run forecasts.

The US SPF asks every quarter  $t$  for respondents to provide their expected inflation

**Table 2:** The sensitivity of US long-run inflation expectations to inflation surprises

	(1)	(2)	(3)	(4)
Sample	1992Q2-2019Q4	1992Q2-2019Q4	1992Q2-2019Q4	1992Q2-2019Q4
Forecast error	0.0126*** (0.0016)	0.0125*** (0.0016)	0.0118*** (0.0016)	0.0189*** (0.0019)
Constant	-0.0342*** (0.0029)	-0.0342*** (0.0029)	-0.0341*** (0.0029)	-0.0338*** (0.0030)
Observations	11,528	11,528	11,539	11,539
R-squared	0.104	0.102	0.081	0.014
Sample	2022Q1-2025Q3	2022Q1-2025Q3	2022Q1-2025Q3	2022Q1-2025Q3
Forecast error	0.0593*** (0.0056)	0.0549*** (0.0055)	0.0367*** (0.0047)	0.0528*** (0.0044)
Constant	-0.106*** (0.0121)	-0.0995*** (0.0120)	-0.0730*** (0.0114)	-0.0962*** (0.0114)
Observations	1,314	1,314	1,316	1,316
R-squared	0.376	0.370	0.323	0.143
Quarter FE	YES	YES	YES	-
Forecaster FE	YES	YES	-	-
Horizon FE	YES	-	-	-

Note: Letting  $\pi_{t,t+j}$  be annual inflation between quarter  $t$  and  $t + h$ , and  $\mathbb{E}_{i,t}$  be the forecast made by person  $i$  in quarter  $t$ , then each column reports the estimates of a panel regression where on the left-hand side is the change in the long-run forecast between  $h$  quarters ago and this quarter by responder  $i$ :  $\mathbb{E}_{i,t}(\pi_{t+36,t+40}) - \mathbb{E}_{i,t-h}(\pi_{t+36-h,t+40-h})$  and on the right-hand side is her/his forecast error for inflation this quarter given her forecast  $h$  quarters ago:  $\pi_t - \mathbb{E}_{i,t-h}(\pi_t)$ . Standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

10-years ahead, so  $T = 36$ , as well as 1, 2, 3, and 4 quarters ahead, so  $h = 1, 2, 3, 4$ . Table 2 shows the results of estimating this regression, where the first column has the baseline specification, while columns 2-4 remove each of the fixed effects to isolate the impact that the variation across horizons, time, and forecaster in pinning down the estimates. In the sample before the inflation surge, between 1992 and 2019, the estimates are between 0.012 and 0.019. These are statistically significantly different from zero, but quantitatively small.

**Table 3:** The sensitivity of EA long-run inflation expectations to inflation surprises

	(1)	(2)	(3)	(4)
Sample	1999Q4-2019Q4	1999Q4-2019Q4	1999Q4-2019Q4	1999Q4-2019Q4
Forecast error	-0.0192 (0.0232)	-0.0192 (0.0232)	0.00626 (0.0226)	0.0168 (0.0104)
Constant	-0.0055 (0.0046)	-0.0055 (0.0046)	-0.0060 (0.0048)	-0.0061 (0.0048)
Observations	1,213	1,213	1,218	1,218
R-squared	0.182	0.182	0.041	0.005
Sample	2022Q1-2025Q3	2022Q1-2025Q3	2022Q1-2025Q3	2022Q1-2025Q3
Forecast error	0.0912** (0.0366)	0.0912** (0.0366)	0.1080*** (0.0313)	0.0457*** (0.0072)
Constant	-0.0833** (0.0419)	-0.0833** (0.0419)	-0.1060*** (0.0392)	-0.0355* (0.0209)
Observations	227	227	238	238
R-squared	0.397	0.397	0.183	0.141
Quarter FE	YES	YES	YES	-
Forecaster FE	YES	YES	-	-
Horizon FE	YES	-	-	-

Note: Same as table 2, but where the long-run is 5 years ahead.

The bottom panel in the table has the same estimates using the post 2022 data. They are 2.8–4.7 times larger. Arguably, they are still small: a 1 percentage point forecast error in inflation leads to a revision of long-run expected inflation by 6bp at most. But, the scars from the disaster are clearly visible.

Table 3 repeats the exercise for the EA. Now,  $T = 16$  or  $20$ , depending on whether the survey was taken in Q1–Q2 or Q3–Q4. The horizons are limited by asking only for inflation at the end of year and two years ahead. Subject to being more imprecisely estimated, the estimates are not so different for the EA from what they were for the US in the pre-disaster era. After 2022, they rise by even more than they did in the US. The scars on unanchoring are more visible.

## 2.6 Market expectations of the policymakers' response

The theory at the start of this section showed that inflation expectations matter more for inflation outcomes the smaller is the parameter  $\phi$ , which measures the responsiveness of policy rates to inflation deviations from target. Several papers in the literature have used market expectations to measure whether  $\phi$  changed during this time, and how much this contributed to the hike in inflation.

Bocola et al. (2024) measure the association between unexpected changes in nominal interest rates and unexpected changes in inflation, by using the changes in the prices of futures markets on nominal and inflation-indexed government bonds. They find that this relation became significantly weaker in 2020-22 relative to what it was in 2017-19. This is a sign that  $\phi$  fell, which would strengthen the impact of the changes in long-run inflation expectations on inflation outcomes today.

Bauer, Pflueger and Sunderam (2024) use expectations from a US survey of professional forecasters across different variables and different horizons to estimate  $\phi$ . They find estimates very close to zero during 2021, which then sharply rose after March 2022, when the Fed started raising rates. The estimates stabilized at a higher level in 2023. A similar pattern holds in EA data. On the positive side, these findings suggest that raising policy rates may be more powerful in curbing inflation because it also shifts expectations that policy will be tighter, attenuating future shocks. On the negative side, it suggests that the perception that monetary policy would not respond to inflation may have played a role in unanchoring expectations.

## 2.7 Were long-run market expectations well anchored?

It depends. Looking back, across estimates, expectations were well anchored before 2020. In 2021, long-run market expectations drifted a little in response to the shocks and amplified their impact on inflation outcomes. This was not a result of the short-run movements in inflation or in short-run expected inflation. Quantitatively the unanchoring was less than one percentage point, and long-run market expectations by 2025 are close to the levels that it had before the inflation surge.

Looking ahead, there are scars from the disaster in expectations, in both the higher willingness to pay for insurance against another disaster, and in the higher sensitivity of expectations to shocks. The anchor is back in place, but not as solidly grounded as it was before.

### 3 Household and firm expectations

Workers negotiate wages with their employers, while firms fix prices taking into account their customers' willingness to pay. Both have to form expectations of inflation in order to fix wages and prices in nominal terms. If they expect higher inflation, they will raise wages and prices, which in turn causes inflation. Through this mechanism, a shock that raises inflation will persist in its effects if it causes second-round effects on wages and prices through inflation expectations. This section looks at data on expected inflation from the households who supply labor and manage firms to investigate this Keynesian nominal-rigidities mechanism driving inflation.

#### 3.1 Theory: the Keynesian / nominal rigidities mechanism

The organizing principle of most theories of nominal rigidities is a Phillips curve relation. It shows how fluctuations in nominal prices will be systematically related to fluctuations in quantities. If workers and/or firms make plans for wages and/or prices in nominal units, and are willing to supply more or less labor and/or goods when inflation is higher, because it lowers the relative prices of what they supply, then monetary policy, by affecting inflation, is not neutral with respect to real quantities.

Regardless of how these nominal rigidities are modeled—whether it is incomplete contracts, risk sharing, limited attention, slow diffusion of information, fixed menu prices, or another of the many alternatives the literature has provided—once linearized and simplified, most of these models lead to the relation:

$$\pi = \mathbb{E}^h(\pi) - \kappa(u - u^*) + s. \quad (4)$$

The variable  $u$  stands for unemployment while  $u^*$  is its level when the nominal rigidities are not binding. The coefficient  $\kappa$  is the slope of the Phillips curve. The variable  $s$  is typically referred to as a supply shock, since it stands for shocks to marginal costs or markups that introduce a wedge between the prices and wages set and those that would hold without rigidities.

The expectations operator  $\mathbb{E}^h(\pi)$  refers to an aggregator of the expectations of the firms choosing the consumer prices, as well as of the firms selling intermediate inputs, and of the workers providing labor. Financial markets are one of these inputs, since funding is needed for production, but they are far from being especially relevant. Rather, these

are the expectations of the households who work for firms and who run them. While larger firms get a larger weight because they sell more output, smaller firms have more intense nominal rigidities (they pay less attention or adjust prices less often). It is the combination of size and extent of pricing frictions that determines the weights in the aggregator behind this expectation.<sup>7</sup>

Different models of nominal rigidities will have different timings for when these expectations are formed and on the precise horizon of inflation: in some models this is the expectation today of inflation in the next period, in others it is the expectation in the previous period of inflation today, but there are variants for all tastes. Common between them is that this aggregator of expectations is dominated by the short horizons.

To conclude, it is household short-horizon expectations, say one year ahead, that are relevant for this channel.<sup>8</sup>

## 3.2 The basic data: household expectations

In some models, like the elegant model of Calvo (1983), the aggregator of beliefs of different workers and firms in  $\mathbb{E}^h(\pi)$  is the simple arithmetic average expectation. In others, like the original model of Taylor (1980), it was a particular weighted average. In each model of nominal rigidities, the aggregator will be different. Unless an empirical researcher is willing to commit to one particular model, then it is wiser to try to capture the distribution of beliefs, for instance through some of its key moments.

Figure 4 shows the average and standard deviation of the survey answers on 1-year expected inflation from the Michigan survey from Fofana, Patzelt and Reis (2024). The moments are calculated over the residualized answers that take out the influence of age, gender, education, and income, so that the distribution of answers is purged from changes in the composition of the sample across these observables that are well known to affect expectations.<sup>9</sup>

Noticeably, it was not just average expected inflation that rose in 2021. The disagreement between households also rose. Moreover, it has stayed high since then, even as the

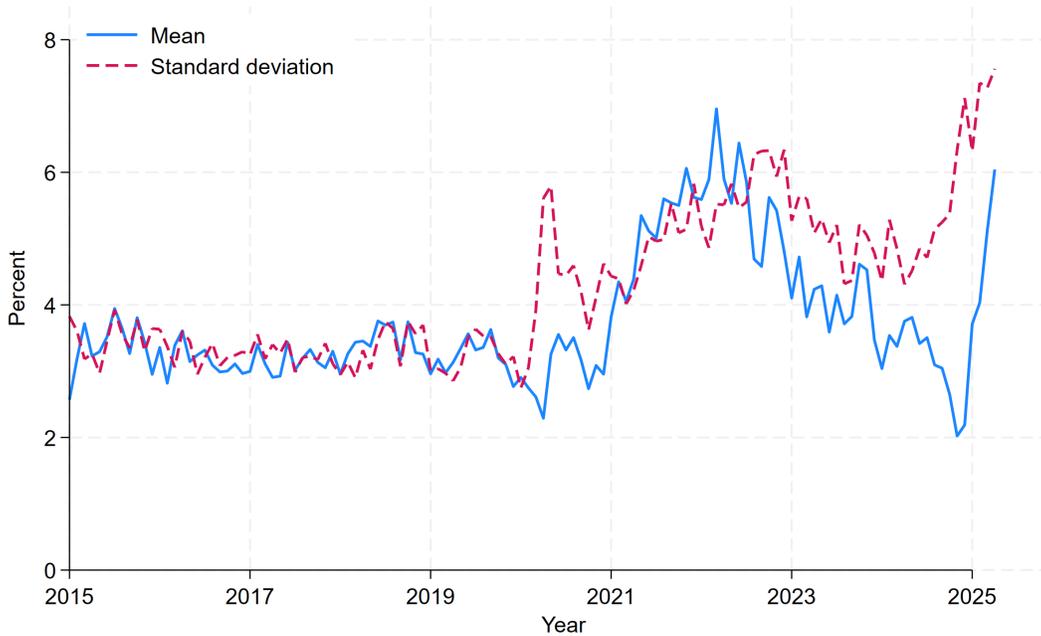
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<sup>7</sup>It is an unfortunate mistake to equate the  $\mathbb{E}^h(\cdot)$  with final goods' firms expectations or with only larger firms, as opposed to, say, the large mass of uninformed workers, forgetting that this Phillips curve is not a pricing conditions for these firms, but rather it is an equilibrium relation that results from aggregating the expectations of every agent in the economy involved in production (Reis, 2023b).

<sup>8</sup>See also Werning (2022).

<sup>9</sup>See Binder and Ryngaert (2024) for a review of data sources for household and firm surveys of expected inflation.

**Figure 4: One-year ahead household expected inflation in the US**



Notes: The figure shows the first and second moments of the distribution of household expected inflation, taken from the Michigan survey, and residualized to take into account fixed household characteristics. Data from <https://r2rsquaredlse.github.io/web-disagreement/>.

mean went down.

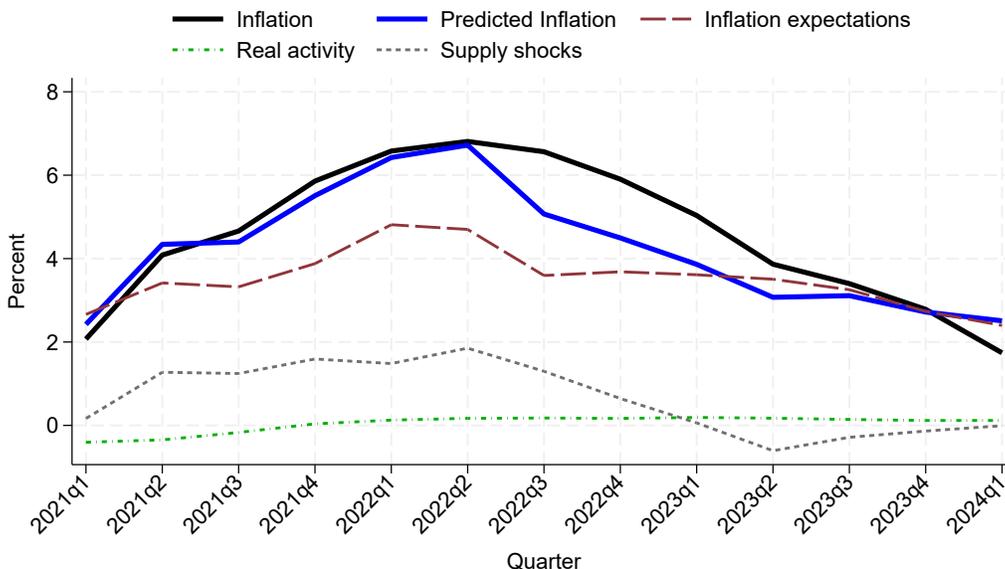
### 3.3 Forecasting inflation

Even though it is central in Keynesian theories of inflation, the Phillips curve has had a bad reputation as an empirical relation since at least the 1970s. During that decade, inflation and unemployment both rose for many years, seemingly breaking down the Phillips curve’s predicted negative relation between them first noted by Phillips (1958) for the UK and by Samuelson and Solow (1960) for the US. Since then, researchers have noted that once one takes into account the expectations and supply shocks terms, respectively, then one could discern again the downward sloping relation (Blanchard, 2016). In this section, I focus on this empirical side of Phillips curve applied to the 2021-24 period.

Consider the augmented US Phillips curve:

$$\underbrace{\pi_t}_{\text{Inflation}} = \beta_0 + \underbrace{\beta_1 \pi_t^e + \beta_2 d_t^e}_{\text{Expectations}} + \underbrace{\beta_3 (u_t - u_t^n)}_{\text{Labor Market}} + \underbrace{\beta_4 s_t}_{\text{Supply Shocks}} + \varepsilon_t. \quad (5)$$

**Figure 5:** Forecasting inflation in 2021–24 using a model estimated before the pandemic



Notes: Actual and predicted inflation from regression equation 5, where  $\pi^e$  is the mean of residualized expected inflation answers to the Michigan survey,  $d^e$  is the standard deviations of these answers,  $\hat{u}$  is unemployment rate minus the natural rate, and  $s$  is the PCE energy inflation index. The prediction is decomposed into the predicted value from just considering each of the three predictor variables, so the three components add up to the predicted series. Estimation period is 1984Q1-2020Q1 while forecasting evaluation period is 2021Q1-2025Q2

On the left-hand side is inflation. On the right-hand side are measures of the three drivers according to theory. For inflation expectations, I use the mean and standard deviation of the distribution showed in figure 4. To measure slack in the labor market, I use the difference between the unemployment rate and the non-cyclical rate of unemployment calculated by the Congressional Budget Office. To measure supply shocks, I use the energy price index of the PCE. Estimating this equation using US data between the first quarters of 1984 and 2020 gives a reasonably good fit.

Figure 5 extends an insightful exercise by Hazell (2025). It uses the point estimates of equation (5) from this earlier sample and the realized values of the right-hand side variables from 2021 onwards to predict inflation during the disaster period. Remarkably, the predicted inflation lines up well with the actual realized inflation. There is no breakdown of the Phillips curve. The inflation surge of 2021-24 was entirely predictable using

**Table 4:** Forecasting performance of Phillips curves for inflation

<i>Forecasting model</i>	RMSE (in %)
No expectations variables	2.566
Baseline model	1.894
Including tightness and a kink	1.965
Including global supply pressures and food prices	2.31
All variables	2.696

Note: The first specification includes only the difference between the unemployment rate and the natural rate. The baseline specification includes the unemployment gap and the mean and standard deviation of expectations, as well as the PCE energy price index, as in figure 5. The next specification includes the log of the vacancy-unemployment ratio allowing for a kink in the slope when this exceeds one to the baseline, while the following one includes the PCE food price index, and the global supply chain price index. Finally, the last specification includes all of the labor market and supply shocks variables together.

the pre-2020 Phillips curve.<sup>10</sup>

Table 4 unpacks what is behind this result. It estimates different versions of equation 5 in the 1984Q1-2020Q1 period, and calculates the root mean squared error of their predictions in the 2021Q1-2025Q2 period. The first row has the result from using the unemployment gap variable as the sole predictor. The next column has the baseline specification, whose fit was displayed graphically in figure 5. As in the 1970s, the improvement is noticeable from including expectations and measures of supply shocks.<sup>11</sup>

The other rows in the table dissect this exercise further. Researchers have long argued that measuring slack requires moving beyond unemployment gaps. Moreover, following the 2021-24 episode of high inflation and little unemployment, while the previous decade had volatile unemployment and little inflation, some researchers have argued that the Phillips curve is non-linear, flat for low inflation, but steep for high inflation. One way to model these new perspectives on the slack variable, due to Benigno and Eggertsson (2023), is to use the ratio of vacancies and unemployment, and to allow it to have a different slope when that ratio is above versus below one. Doing so, the table shows that the

<sup>10</sup>Beaudry, Hou and Portier (2025a) likewise find a stable Phillips curve with a dominant role for inflation expectations using a richer empirical model of inflation dynamics.

<sup>11</sup>Brandão-Marques et al. (2023) more thoroughly investigates the power of the distribution of inflation expectations in predicting inflation, and finds it is important to include second, and even third, order moments.

improvement in forecasting performance is minimal.

A parallel literature developed in response to the inflation disaster emphasizing a better measurement of the supply drivers of inflation. Particularly notable was the global supply chain price index of Benigno et al. (2022), an index that captured the cost of transporting goods across the world using multiple indicators, which were in the news focus in the second half of 2021. Moreover, the invasion of Ukraine by Russia led to increases in the price of commodities, especially food, which drove the next news cycle about inflation in the first half of 2022. Yet, the table shows that including these two measure of supply shocks though, significantly worsens the predictive power of the Phillips curve.

The final row includes both the extended measures of labor market slack, and the measures of supply shocks all at once. The over-fitting of such a specification leads to a significant decline in performance. In fact, better than these elaborations on how to measure slack and supply shocks, one would be better off going back to only using the unemployment gap.

These results show the importance of taking into account expectations when estimating Phillips curves. In a prediction exercise, the advantages of including kinks in the slope of Phillips curve, considering vacancies, including both energy and food prices, and devising new measure of supply chain problems, all disappear once one includes expectations of inflation. One would miss this result by using as the variable for expectations the mean forecast of long-run inflation from the SPF survey. This is the incorrect measure both in its horizon and on who is being asked.<sup>12</sup>

### 3.4 The stability of the Phillips curve

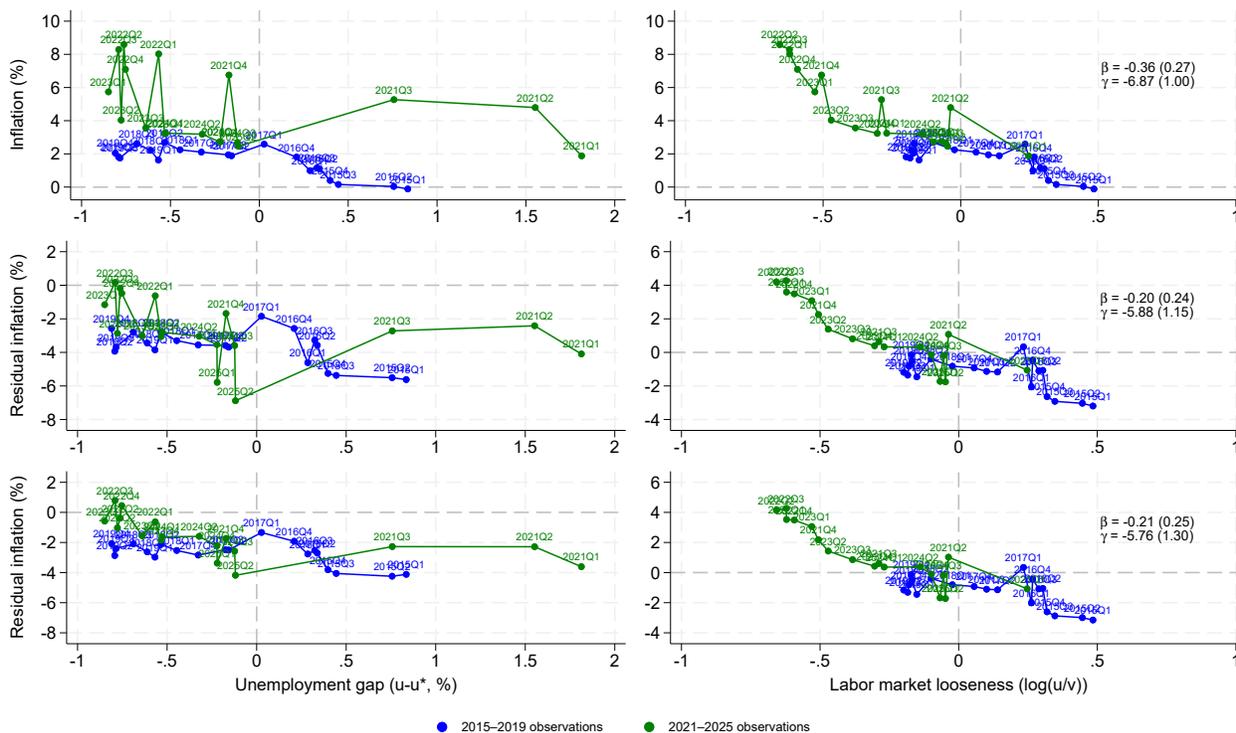
Figure 6 conducts a related exercise with a different goal. Instead of asking whether expectations variables helped in predicting the inflation surge, it asks whether the inflation-unemployment relation stayed stable throughout this period. While the previous section considered the role of expectations in the Phillips curve out of sample, here we study their role in sample.

The top-left panel shows the plot of inflation against the unemployment gap, distinguishing between the 5 years before the pandemic, and 5 years after, while omitting 2020.

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<sup>12</sup>Unpacking the mechanism behind this prediction ability, Meyer and Sheng (2025), Baumann et al. (2024), Asghar, Fudurich and Voll (2023), Ghassibe, Wanengkirtyo and Yotzov (2025) found that firms that expect higher inflation raised their prices, and Jordà and Nechio (2023) found that during the pandemic, the passthrough from inflation expectations to higher wages increased by a factor of five.

Figure 6: Phillips curves



Notes: The top row plots quarterly observations of CPI inflation and measures of slack for the pre-pandemic period, and the inflation-surge period. The second row residualizes inflation by the predicted component by expected inflation (mean and standard deviation), and the third row by the predicted component from expectations and supply shocks (gas prices and the global supply pressures index). The measure of slack in the left column is the difference between the unemployment rate and the CBO non-cyclical rate of unemployment. The measure of slack in the right column is the log of the unemployment-vacancies ratio. The coefficient estimates are from  $(\beta + \gamma I(u/v)) \log(u/v)$ , where  $I(\cdot)$  is an indicator function equal to one when  $\log(u/v) < 0$ .

Before the pandemic, this Phillips curve plot was stable and quite flat. Afterwards, and especially from 2021Q4 onwards it becomes erratic, with no discernible slope. The right-hand side top plot replaces the unemployment gap with the log of the unemployment-vacancies ratio allowing for a kink when this is positive. Confirming earlier results, the Phillips curve is flat (0.36) when unemployment is above vacancies, but much steeper (7.23) when vacancies are higher and labor markets are tight.

The top panel, however, does not control for inflation expectations. Not only should their movement have shifted the curve, but they may also be responsible for the steepening of the relation, as households are learning about the supply shock (Erceg, Linde and

Trabandt, 2024), firms pay more attention and update their prices more often in response to more volatile inflation (Morales-Jimenez and Stevens, 2025, Pfäuti, 2023, Blanco et al., 2024, Bracha and Tang, 2024) or in response to dovish policy (Afrouzi and Yang, 2017).

The second row includes expected inflation as a control, using the mean and standard deviation of the 1-year ahead residualized answers in the Michigan survey. On the left plot, the observations in the inflation disaster period are now less erratic. On the right plot, the fit is also noticeably better. The kink in the Phillips curve is still present, even though it is not as large.<sup>13</sup>

The third row adds the variables for supply shocks, and finds they make little difference. As with forecasting, controlling for expected inflation is important, but once one does so, controlling for supply shocks is not much so.<sup>14</sup>

Experiments with surveys of households and firms show that across many countries during the inflation surge, people become more informed about inflation (Weber et al., 2025). This may have made the inflation expectations series better incorporate the information from supply shocks. Since the economic agents would do so in the way that is more relevant to them, then survey expected inflation becomes a better statistic for inflation than the supply shocks themselves.

### 3.5 Supply shocks as drivers of expectations

Having looked at the expected inflation and real activity terms in the Phillips curve, we now turn to the usefulness of expected inflation in learning about the mechanisms from supply shocks to actual inflation.

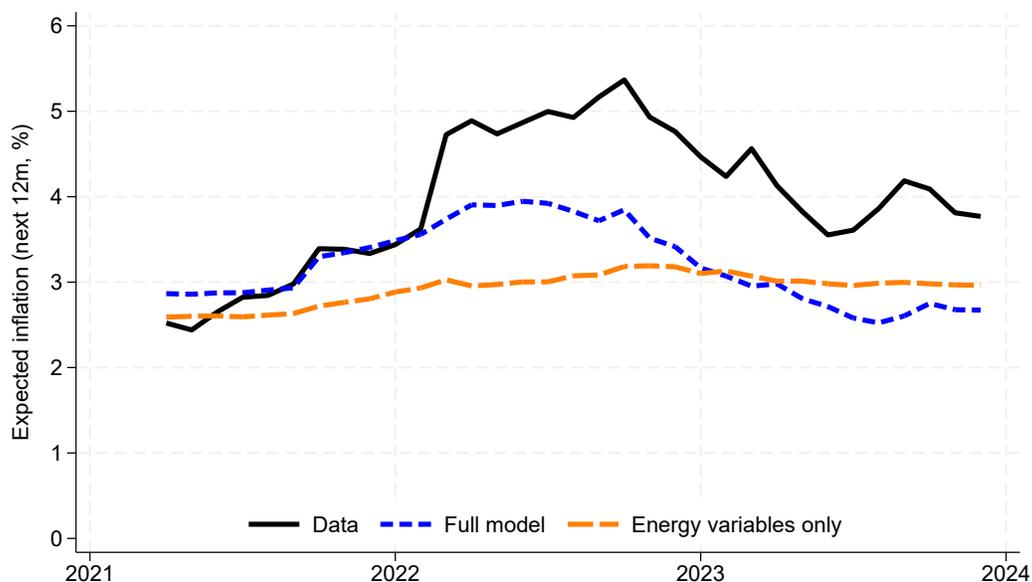
A small literature has shown that households' 1-year inflation expectations are especially sensitive to changes in energy prices (D'Acunto and Weber, 2024). They are often cited by households as one of the main sources of information that households look at when forming their expectations. At the same time, when this effect is quantified, the impact of energy prices on expected inflation is lower than either their information value or their weight on the consumption basket (Patzelt and Reis, 2024). Households are inattentive to all news, even if relatively less so to energy news.

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<sup>13</sup>Beaudry, Hou and Portier (2025b) using recent cross-city evidence likewise find a stable Phillips curve, but differently find no statistical signs of a non-linearity. Looking farther back in time, Doser et al. (2023) also reject non-linearities in the Phillips curve. The key point in both papers, and in the analysis in this section, is that controlling for short-term inflation expectations makes a very large difference.

<sup>14</sup>Acharya et al. (2023) provide a rich analysis of how supply shocks and inflation expectations interacted during the inflation disaster.

**Figure 7:** Energy prices do not drive inflation expectations



Notes: EA household expected inflation 12-months ahead. Mean of responses and predicted values taking into account only energy prices, and energy prices together with lagged inflation and monetary policy.

In 2021-22 there was a large increase in energy prices, at first as a result of the pandemic, and afterwards due to Russia's invasion of Ukraine. This would have a direct impact on inflation in the Phillips curve. An indirect, but potentially relevant, further impact would come if the supply shocks raised expected inflation and through it actual inflation. To judge if this is so, I use the specification of Patzelt and Reis (2024). It uses the cross-regional variability in electricity prices within the EA to identify their impact on individual inflation expectations.

Figure 7 shows two predicted values from their regression. The first comes from using all the variables, both energy prices and controls, and the second from only the energy price variability. According to these estimates, the sharp increase in energy prices might have raised expected inflation by somewhere between half and one percentage points. This is between one tenth and one third of the increase in expected inflation during this time. According to these estimates, the transmission from supply shocks to inflation through expected inflation was quantitatively small. These results suggest that policies to control inflation by putting price controls on energy prices to dampen expectations may not be all that effective.

### 3.6 Were short-run household expectations well anchored?

It depends. The distribution of these expectations moved significantly during this time, as one would expect given the large movements in actual inflation. In doing so, they amplified the impact of the shocks themselves. The Phillips curve was stable during the inflation surge, and it predicted well the movements in inflation, with expectations playing a key role in those predictions.

At the same time, while the energy shocks played a role in moving expectations, quantitatively they accounted for less than one quarter of their movement. Moreover, once taking into account the changes in expected inflation, it is hard to statistically see an additional direct impact from the measures of supply shocks themselves into inflation outcomes. Inspecting the expectations mechanism casts doubt on a shock account that put too much weight on supply shocks during the inflation disaster.

## 4 Institutional expectations

Governments in advanced economies issue their public debt mostly in units of the national currency. When they are unwilling or unable to have the requisite fiscal surpluses to service the past debt, higher inflation is one way to keep the real value of the debt from rising. Expected inflation lowers the real value of outstanding debts, but raises the cost of servicing debt from then onwards. Unexpected inflation is more effective, and inflation disasters often come hand-in-hand with fiscal crises. This section presents the mechanism that goes from fiscal shocks to unexpected inflation, and discusses the expectations from the institutions that monitor the evolution of the public debt.

### 4.1 The fiscal mechanism

The government budget constraint links the evolution of the amount of debt due today that was issued last period  $B_{t-1}$  to the surplus as a ratio of GDP ( $Y_t$ ) on the public accounts  $S_t$ , and the revenue from selling new debt at price  $Q_t$ :

$$B_{t-1} = P_t Y_t S_t + Q_t B_t. \quad (6)$$

Let  $b_t = B_{t-1}/P_t Y_t$  be the debt-to-GDP ratio today. Then, since the return on the debt is  $1 + i_t = 1/Q_t$  and real growth and inflation are, respectively,  $g_t = Y_t/Y_{t-1} - 1$  and

inflation  $\pi_t = P_t/P_{t-1} - 1$  it follow that the debt-to-GDP ratio evolves according to:

$$b_{t+1} = \left[ \frac{1 + i_t}{(1 + \pi_t)(1 + g_t)} \right] (b_t - s_t) . \quad (7)$$

Mechanically, higher inflation lowers the right-hand side, and thus leads to a lower debt. However, if investors expected the inflation they would have required a higher nominal interest rate to compensate them. If that adjustment was one-to-one, then the right-hand side would be unchanged, and so would the debt-to-GDP ratio. Worse, if attempts at having high inflation to lower the debt lead those investors to require an extra premium to compensate for this inflation risk, then the higher expected inflation may actually worsen the government's fiscal position.

What happens to the interest rate depends ultimately on how those who lend to the government perceive the value of its debt. The common assumption in economics is that, from today's perspective, they discount payoffs at a future date  $T$  by a discount factor  $M_{t,T}$  that has the property that in the limit at infinity, the discounted debt-to-GDP ratio is zero. The key behavioral assumption is then that the government is not expected to run a Ponzi scheme on the bond holders. It is their expectations, denote them by  $\mathbb{E}^b(\cdot)$  that matter.

Multiplying by the discount factor and taking expectations gives the integral version of the budget constraint:

$$\begin{aligned} \frac{B_{t-1}}{P_t Y_t} &= \sum_{j=0}^{\infty} \mathbb{E}_t^b \left[ M_{t,t+j+1} \left( \frac{1 + i_{t+j}}{(1 + \pi_{t+j})(1 + g_{t+j})} \right) S_{t+j+1} \right] \\ &+ \sum_{j=0}^{\infty} \mathbb{E}_t^b \left[ M_{t,t+j+1} \left( \frac{1}{M_{t+j+1}} - \frac{1 + i_{t+j}}{(1 + \pi_{t+j})(1 + g_{t+j})} \right) \right] \frac{B_{t+j}}{P_{t+1+j}} . \end{aligned} \quad (8)$$

The real value of the debt is on the left-hand side. It equals, on the right-hand side, the present value of primary surpluses plus the revenue from issuing public debt and paying for it a lower interest rate than the rate at which investors discount the future.

Say that that there is an unexpected decline in surpluses, for instance because of the large expenses in the pandemic, or because of the fiscal stimulus programs in 2021. Then, on the left-hand side, this will be accompanied by an unexpected increase in inflation in that year.

In turn, that inflation and the losses it imposes on the bondholders will raise questions

over the liquidity and safety of government bonds. The same questions arise from the expected future deficits and the prospect of financial repression or partial default. These reduce the gap between the discount rate and the interest rate, reducing the second term on the right-hand side. Again, this will come with unexpectedly higher inflation on the left-hand side.

The account on the previous paragraph could be taken as a casual connection from the right-hand side to the left-hand side. This is the fiscal theory of the price level (Cochrane, 2023). But, since the equation above only requires a no-Ponzi scheme condition on government bonds, it holds in almost all other theories of inflation as well. Going from the left to the right sides of the equation instead, it says that unexpected inflation is one way to compensate for future deficits or for a loss of trust by investors on the government debt. That unexpected inflation can be the result of benign neglect by the central bank (Hall and Sargent, 2025) or may be part of the optimal way to finance the deficits from a war or a pandemic (Lucas and Stokey, 1983). Whichever theory one takes on which policy drives inflation, whether it is fiscal or monetary, this equation still holds and captures the fiscal mechanisms connecting shocks to inflation.

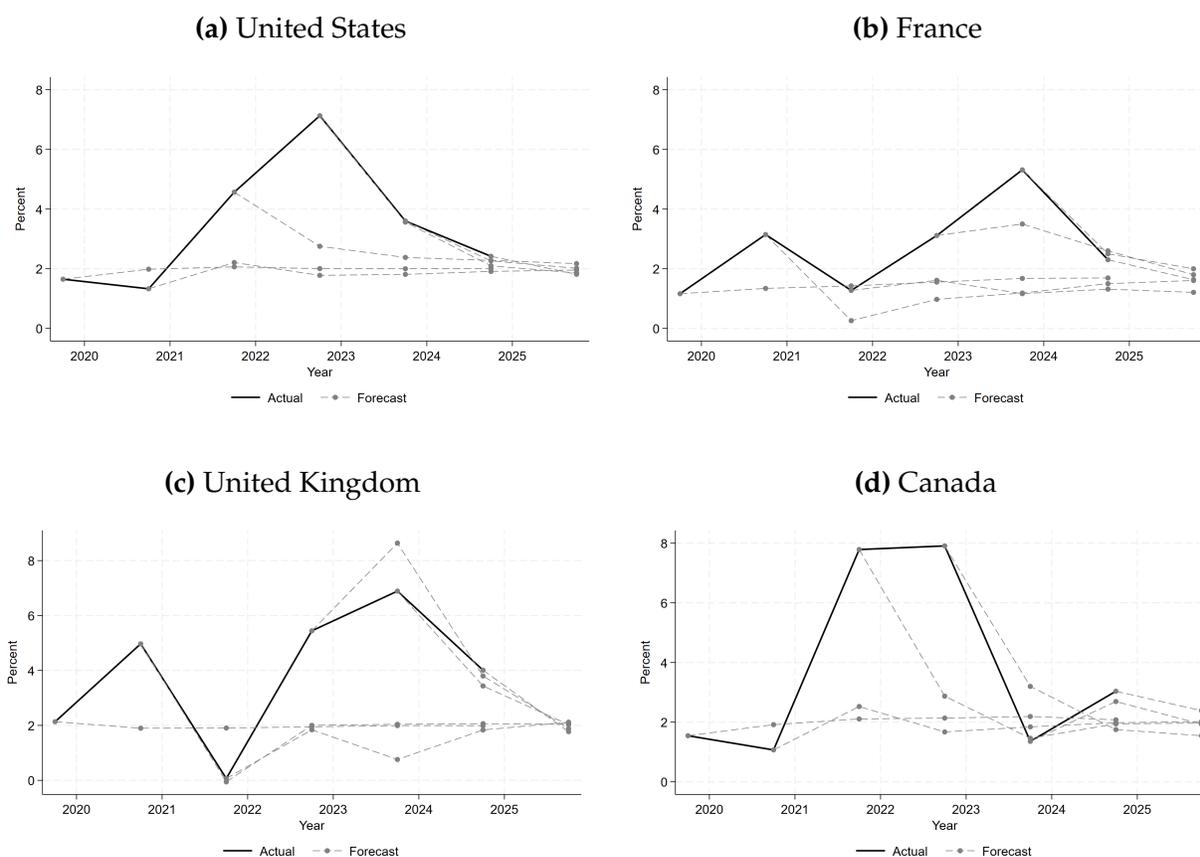
This mechanism makes clear that the expectations that matter are those of the ultimate holders of the government debt, the ones who will be willing to lend to the government and not let itself be sucked into a Ponzi scheme. In part, these are the expectations of markets that we already studied in section 2. But in another part, they are the expectation of the institutions that, if and once markets withdraw, will step in and lend to the government.

The theory connects their expectations of inflation with their expectations of the fiscal plans of the government. Fortunately, these institutions produce and make public their joint expectations for these variables.

## **4.2 The basic data: inflation expectations of the IMF staff**

Institutions like the International Monetary Fund (IMF) or the European Stability Mechanism (ESM) spend considerable resources and accumulate expertise in forming forecasts of the fiscal situation and inflation. Their expectations are important not just in the (fortunately rare) occasions when these institutions are called to lend to governments. They also serve as the basis for many investors in the public debt to form their views. Importantly, and unlike most surveys or markets, they form expectations for the different components of the budget constraint above, in a way that is coherent and satisfies the

**Figure 8: IMF inflation forecasts and actual inflation in four countries**



Note: This picture shows actual inflation, and the forecasts of inflation for 1 to 4 years ahead. Data comes from the April and October issues of the World Economic Outlook.

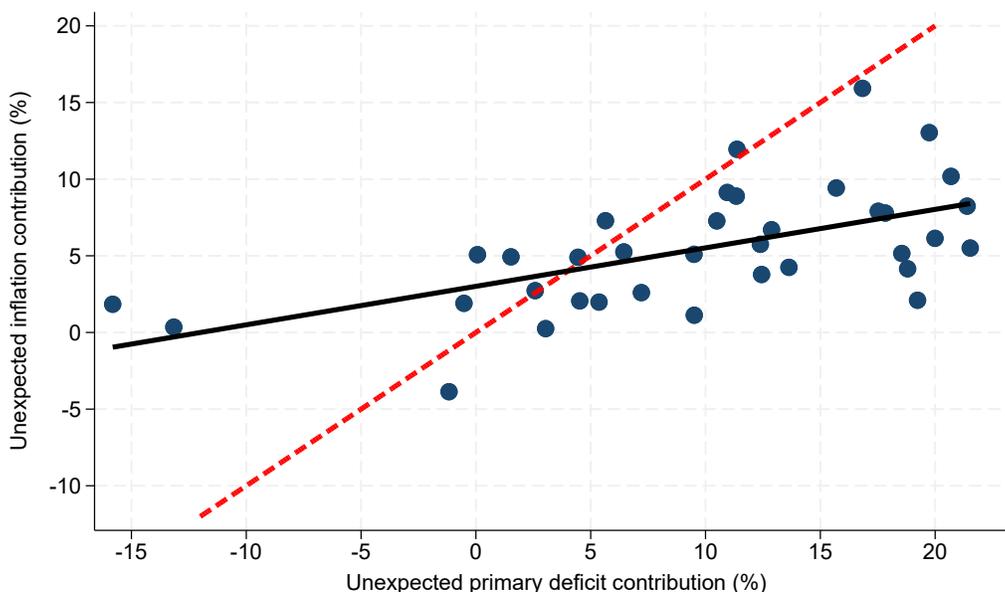
accounting identities.

Figure 8 shows the annual expectations of the IMF staff on what inflation would be for the coming five years. These come from the IMF’s flagship publication, the World Economic Outlook. Like markets and households, the IMF did not see the inflation surge coming. Like many, it forecasted the rise in inflation would be transitory, and yet it was later surprised by how quickly inflation fell. But, to a larger extent than markets or households, the IMF’s expectations were solidly anchored, since they did not rise as much as inflation rose, and they were quicker to revert back on target.

### 4.3 Inflation and fiscal surprises

To inspect the fiscal mechanism, I compare the IMF’s 2019 forecasts for the increase in the public debt over the next 5 years, with the actual increase that we saw.

**Figure 9:** Contributions of deficits and inflation to the unexpected increase in public debt



Note: Using the WEO 2019 forecasts in October 2019, and the WEO actual outcomes in April 2025, I construct the unexpected increase in public debt between 2019 and 2024 due to unexpectedly high primary deficits and the unexpected decrease in public debt due to unexpectedly high inflation, for each country in the OECD. Also plotted is a 45 degree line, and a linear regression, which has a coefficient of 0.25 and a standard error of 0.06. The two left outlier points are Norway and Denmark, which had large surpluses; excluding them from the regression, the slope rises to 0.31, with standard error 0.08.

The IMF also puts out forecasts for each term in the accounting identity linking current to future debt in equation (7). Using these forecasts, I constructed the expected increase in debt due to expected inflation, interest rates, economic growth, and fiscal deficits. Then, using the April 2025 actual values for what each of these variables were, I constructed the actual increase in public debt due to the actual evolution of each of these four variables. Subtracting one from the other give the unexpected increase in public debt, broken down into four unexpected terms, for each country in the WEO sample.<sup>15</sup>

Figure 9 plots two of these terms: the unexpected increase in public debt due to unexpected deficits, and the unexpected increase in the debt due to inflation in 2019-25 per country. The figure shows a clear positive relation, which is statistically significant. This says that for countries where deficits turned out to be higher than the IMF expected, infla-

<sup>15</sup>See also Brandao-Marques et al. (2024) for the impact of debt surprises on long-term inflation expectations. Ilzetki (2023) looks at five case studies of fiscal shocks and the anchoring of inflation expectations.

tion also turned out to be unexpectedly higher, using the common metric of their impact on the public debt. The fiscal mechanism is validated using the expectations data.<sup>16</sup>

Moreover, these correlated forecast errors across the two variables would justify a revision of procedures by a rational forecaster. If fiscal developments lead the IMF to raise its expected deficits, then this past experience should lead it to raise its expected inflation as well. Even if it does not, the bondholders that choose to hold the public debt of these countries, and who have their money at stake, would rationally do so. They would correspondingly raise the interest rate charged on the debt (or lower the price they are willing to pay for it). In this sense, insofar as one might expect that fiscal news will be negative, inflation expectations of bondholders may become less anchored.<sup>17</sup>

#### **4.4 Were institutional expectations well anchored?**

It depends. On the one hand, the inflation forecasts of the IMF did not drift as far up as others, and were quicker to stabilize. On the other hand, this implied that the IMF overstated the increase in public debt since 2020, by not taking into account the use of the “inflation tax” to pay for some of the extra spending. If institutions, and ultimately bondholders, revise upwards their procedures to more closely tie inflation forecasts to the forecasts of fiscal deficits, this would unanchor inflation expectations.

## **5 Policymakers’ expectations**

Because monetary policy works with a lag, the setting of policy tools must be done with an eye on the future. Therefore, a large part of the job of a central banker is to make forecasts about the future of the economy. Policymakers’ expectations in turn determine how they choose policy, and since policy partly determines what inflation will be, then these expectations matter for inflation.

This is especially true after a shock. Different policymakers will have different beliefs on how that shock affects outcomes, and their response will modulate how this transmission happens. This section describes the aggregate demand channel of transmission of

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<sup>16</sup>Barro and Bianchi (2025) conduct a related exercise with a complementary conclusion: there is a strong relation between realized inflation and realized extra spending during this time across OECD countries.

<sup>17</sup>The model and evidence in Carvalho et al. (2023) supports this channel, and the large forecast errors during the inflation surge have made inflation expectations more sensitive to future forecast errors (Gati, 2023, Gennaioli et al., 2024).

shocks, and looks at policymakers' expectations to learn whether they leaned against the inflation surge in the same way as they had done against other past shocks.

## 5.1 The policy choices over aggregate demand mechanism

It is a common assumption in models of business cycles where aggregate demand policy matters that a policymaker whose expectations are  $E^P(\cdot)$  solves a problem:

$$\min \mathbb{E}^P \left\{ (\pi - \bar{\pi})^2 + \lambda(u - \bar{u})^2 \right\} \quad \text{s.t. equation (4)}. \quad (9)$$

The loss function being minimized penalizes inflation away from a target  $\bar{\pi}$ , and unemployment away from another target  $\bar{u}$ , with the key parameter  $\lambda$  determining how costly are the latter deviation relative to the former. This representation captures the dual mandate of the Federal Reserve, and in that context the size of  $\lambda$  is sometimes referred to as the degree of dovishness.

The constraint in this maximization is the Phillips curve tradeoff discussed earlier.

As for the variable being chosen, take it to be the actual value of inflation (or its expectation). Policymakers may have access to many tools, and some may be better described as fiscal or as monetary. But insofar as policy can have some effect over aggregate demand then it targets a point on the Phillips curve.

This is a consequential approach to inflation: no matter the channel, the key mechanism is how policymakers set policy to achieve a particular feasible outcome. Taking as given the households' expected inflation—a major assumption that the literature on commitment as thoroughly studied—then the optimality condition from this problem is the famous targeting rule:

$$\mathbb{E}^P(\pi - \bar{\pi}) = \frac{\lambda}{\kappa} \mathbb{E}^P(u - \bar{u}). \quad (10)$$

Take the special case where the target for unemployment is the natural rate ( $\bar{u} = u^*$ ), households expect inflation to be on target  $\bar{\pi} = \mathbb{E}^h(\pi)$ , and there are no supply shocks ( $s = 0$ ). Then this equation has zeros on both sides. Policy should try to keep inflation on target, and unemployment will be at its target natural rate as well.

If any of these three conditions does not hold, then this equation expresses how policy will trade off its two goals. Taking the case of a positive supply shock ( $s > 0$ ), then policymakers will tolerate some inflation above target at the same time as unemployment is elevated from target as well. Keeping inflation directly on target would not be optimal

because then unemployment would be higher. The rate at which the two goals are traded off against each other is the ratio of how much the policymaker dislikes unemployment and how much it can trade off inflation against unemployment. If, for instance, policymakers are very dovish ( $\lambda$  high) and the Phillips curve is very flat ( $\pi$  low) then inflation can be significantly above target in order to keep unemployment close to its target.

Expectations are central in this mechanism, and just as in the previous section, what matters is the joint expectation across variables. If policymakers expect a very large recession because of a large supply shocks, then they may tolerate an inflation surge.

## 5.2 The expectations of members of the FOMC

Since 1970, the individual forecasts of different members of the FOMC that sets interest rates in the US has been published semi-annually. Since 2007, these have been quarterly and published as part of the Summary of Economic Projections (SEP), and since 2009 they have also divulged their expected long-run values of inflation and unemployment.

Figure 10 plots the median across policymakers in each survey wave for the objects in equation (10). It separates the data into two separate samples: before the pandemic in blue, and from 2021 onwards in orange.

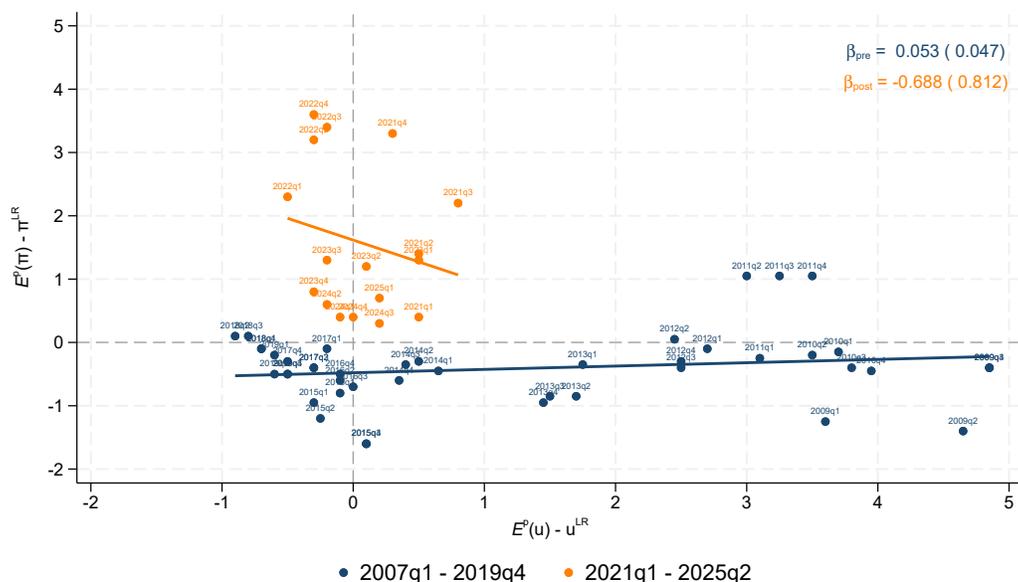
There are several reasons to not expect a perfect linear fit between these points. For one, the horizon of the expectations in equation (10) is tricky to pin down. If the horizon is too long, then by definition of the survey both the left-hand side and the right-hand side are zero. If too short, like one quarter, then the policymaker would not be able to steer inflation with any precision for this optimality condition to hold. We use the expectations of inflation until the end of the year in the SEP. Second, because the target for unemployment need not be the long-run expected value of unemployment. I have tried using the CBO's non-cyclical rate of unemployment with similar results. Third, policymakers may report their expectations strategically to influence the direction of votes or because of career concerns, or may care asymmetrically between inflation above or below target, and likewise for unemployment.

It is still suggestive to note that between 2007 and 2019, the fitted value of  $\lambda/\kappa$  is 0.053. During the inflation disaster period, instead, it became so flat that it even switched sign. Given the stability of the slope of the Phillips curve that we found in section 3, this points to preferences of policymakers becoming quite dovish in 2021.<sup>18</sup>

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<sup>18</sup>From a very different perspective, these data confirm the insight of Giannone and Primiceri (2024) discussed in the introduction.

**Figure 10:** Expectations of inflation and unemployment gaps from FOMC members



Note: Median expected inflation and unemployment from the SEP in each quarter, with the expected value subtracted from its expectations in the long run. Coefficients are simple fitted line by OLS to the two sub-samples.

Beyond the fit, the scatter plot of points tells a clear story. When inflation shot up to two digits in 2021, unemployment was barely above any estimate of its long-run or neutral level. That this did not lead to any tightening of fiscal or monetary policy is hard to explain unless policymakers were quite dovish, or they believed that the Phillips curve was very flat.<sup>19</sup>

## 6 Conclusion

While laying out the mechanisms from shocks to inflation outcomes, and the way in which they are intermediated by inflation expectations, this article went through several disparate pieces of evidence. I collect them here now for ease of reference:

<sup>19</sup>Romer and Romer (2024) argue that this change in preferences was visible in the framework review the Fed did in 2020, as does Reis (2023a), who more precisely traces the changes to both a tightly-held belief that  $r$ -star would be forever lower and to an over-reliance on the Fed's credibility and the anchoring of expectations. Bianchi, Faccini and Melosi (2023) argue that the root of the change was in choosing to accommodate the unfunded fiscal stimulus of 2021.

1. Market long-horizon inflation expectations moved following the shocks in 2021-24, so they were not fully anchored, but those movements can account for less than one percentage point of the movements in actual inflation.
2. The inflation disaster was unexpected, and has left scars in financial markets as the probability of a similar disaster in the far-future is judged to be 2-4 times higher than pre-pandemic.
3. The inflation disaster left scars in professional forecasters, whose long-horizons expectations are 4-10 times more sensitive to short-term shocks than they were before.
4. Households' short-horizon US expectations are persistently higher and more dispersed.
5. Expected inflation was the key leading indicator of the 2021 inflation surge, and forecasts based on a model estimated until 2019 with the inflation expectations data tracked quite well the up and down of inflation in 2021-24.
6. The Phillips curve was stable throughout, with all of its shifts accounted for by the changes in expected inflation.
7. Supply shocks account for at most one third of the rise in expected inflation, and once expected inflation is taken into account, measures of supply shocks do not shift the Phillips curve and they worsen forecasts of inflation.
8. Across countries, unexpected worsening of fiscal surplus is strongly correlated with unexpected increases in inflation.
9. Given that people are paying more attention to inflation, looking ahead, fiscal shocks should have a larger impact on expected inflation.
10. During 2021-24, policymakers' expectations of inflation relative to unemployment reveal a higher tolerance for higher inflation than before the pandemic.

These findings provided a nuanced view of whether inflation expectations stayed anchored throughout the inflation surge, and whether they are as well anchored now as they were before. They gave support to each of the four mechanisms that I presented: (i) the monetary mechanism that long-run expected inflation can move but decisive policy

actions can re-anchor it, (ii) the Phillips-curve mechanism, whereby a shift in the distribution of household and firm near-term expected inflation amplifies shocks, (iii) the fiscal mechanism that links shocks to public deficits to shocks to inflation, (iv) and the policy choices mechanism that links loose policy in 2021 to the preferences of policymakers revealed by their expectations. In terms of shocks, they justify reducing somewhat the weight given to supply shocks in the inflation surge.

At the same time as this article was being written, there were two other articles with some similar goals. I conclude by discussing how my findings and conclusions relate to theirs.

Coibion and Gorodnichenko (2025) also examines survey expectations data to ask whether inflation expectations were anchored during the inflation surge, with an emphasis on the US. My paper devotes more attention to the theoretical mechanisms linking shocks to inflation outcomes, and to how inflation expectations can inform those. On the data, this leads me to examine market prices, and institutional and policymakers' expectations as well, together with data from other countries. Therefore, the contrast between the two is confined to section 3.

In terms of findings, they focus on the role of supply shocks. This paper considered also fiscal and monetary policy as shocks, and found a significantly lower weight to supply shocks once inflation expectations are taken into account. In their conclusion, they focus on how in absolute terms, inflation expectations have always been unanchored, whereas this paper focuses more on whether they were relatively more unanchored during or as a result of the inflation disaster.

Hajdini et al. (2025) discuss the inflation surge, devoting special attention to the balance between supply and demand shocks and to the data on relative price changes and the labor market. I focus exclusively on mechanisms and inflation expectations data.

They touch on inflation expectations in their section 3. Their analysis of short-term inflation expectations of firms and households also concludes that they likely amplified the shocks, but their analysis of long-term expectations concludes that they stayed anchored throughout. By instead looking at market expectations more closely, I conclude that long-run expectations may have somewhat unanchored during the inflation disaster, and are nowadays less anchored than before.

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