HOW MONETARY POLICY GOT BEHIND THE CURVE—AND HOW TO GET BACK

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Inflation Risks

CHAPTER NINE

The Burst of High Inflation in 2021–22: How and Why Did We Get Here?

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Inflation in most western advanced economies has been rising at a fast pace since the middle of 2021. It was tempting (and too common) at the time to dismiss this rise in one of two ways. During the first half of 2021, some noted that there was a normal catch-up of the price level after its sharp fall in 2020 during the pandemic. But this correction became a persistent acceleration by the second half of 2021, which gained further momentum in the first half of 2022, well beyond any reasonable catch-up. Another dismissal came from remembering how central bankers had worried that inflation might be stuck at too low of a level between 2014 and 2019, for instance hovering around 1% and 1.5% in the eurozone. Maybe a year or so of higher than 2% inflation was to be welcome. But, in April of 2022, the one-year inflation rate was 9.0%, 6.3%, and 7.5% in the United Kingdom, the United States, and the eurozone, respectively. Quantitatively, inflation is so far above target that concerns of the recent past that inflation was too low seem trivial.

This essay grew out of speeches and lectures given at Markus' Academy, the 2022 ECB and Its Watchers conference, the BIS annual meetings, the 2022 annual Bradesco/BBI conference, the Norges Bank, the Hoover Institution's 2022 Monetary Policy Conference, and the CICC Global Institute. I am grateful to participants at these conferences for many comments, and to Marina Feliciano, Brendan Kehoe, and Borui Niklas Zhu for research assistance.

Policy makers are worried, as they should be. More than a decade ago, Charles Evans, the president of the Federal Reserve Bank of Chicago and the current longest-sitting member of the Federal Open Market Committee, said in a speech: "Imagine that inflation was running at 5 percent against our inflation objective of 2 percent. Is there a doubt that any central banker worth their salt would be reacting strongly to fight this high inflation rate? No, there isn't any doubt. They would be acting as if their hair was on fire" (Evans 2011). Today, the reality of inflation is already well beyond Evans's imagination, and some central bankers are feeling the heat in their heads. How did we get to this dramatic situation?

The following discussion puts forward four factors behind the recent rise in inflation. The guiding framework is the principle that, ultimately, monetary policy can control inflation. That control is far from perfect, coming with unavoidable misses, and often it is desirable to let inflation deviate from 2% for some time to try to meet other objectives. But, common to all four factors, is a presumption that inflation rose because monetary policy became used to a state of affairs in the past decade and took too long to shift its stance. Rather than highlighting isolated mistakes in judgment, I point instead to underlying forces that created a tolerance for inflation that persisted even after the deviation from target became large. These factors suggest reforms for the future, as well as ways to put out the fire. Perhaps they are of use to the central bankers proving that they are worth their salt. I focus the discussion and the references on the ECB and the Federal Reserve, although the points apply more broadly to other central banks in advanced economies.

THE CONTEXT: TWENTY-FIVE YEARS OF PRICE STABILITY

Before looking at what happened in 2021–22, it is important to step back, and recall how exceptional the previous three decades

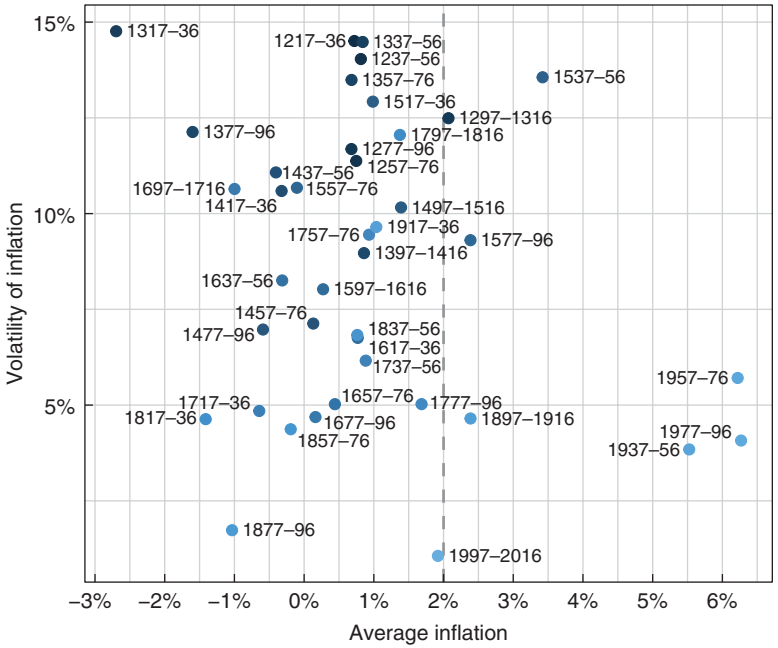

FIGURE 9.1. Eight Hundred Years of Inflation in the United Kingdom, 1217 to 2016

Notes: Data on the annual change in the consumer price index, from the Millennium Dataset of the Bank of England, grouped in twenty-year intervals. Horizontal axis has average inflation, and vertical axis has the standard deviation, both over twenty-year periods.

had been. Between 1995 and 2020, almost every major advanced economy enjoyed a remarkable period of price stability. I first produced a version of figure 9.1 in 2017 for a conference discussing the twenty years of independence of the Bank of England. It shows eight centuries of inflation in the United Kingdom, split into twenty-year periods for which I computed the average and the standard deviation of inflation. Eight hundred years is a long time, and it included many experiments with monetary policy: from the gold standard to floating exchange rates, with monetarism and Bretton Woods thrown in the mix. Some of them got close to the recent past in terms of achieving an average inflation rate near 2%, but they had

much higher volatility. A few had low volatility, but those came with persistent deflation. None worked as well in delivering low and stable inflation as the regime of the last twenty years. Never had monetary policy been so successful at controlling inflation as it had been in the two decades before the pandemic (Miles et al. 2017).

What does this successful regime consist of? In my view, it is based on three pillars. The first is granting central banks independence from the ministry of finance, so that managing the public debt and helping to balance the public finances is no longer a job for monetary policy, and no longer overrides concerns about inflation. It is also important to have independence from governments seeking reelection so that monetary policy is not systematically used to stimulate the economy temporarily, a pursuit that often proves fruitless but results in high and volatile inflation.

The second pillar is the required balance to the first: for a public institution to have the power that we confer upon central bankers, then its mandate must be narrow, its actions transparent, and its performance measurable and routinely measured. The public has given central banks an inflation target that satisfies all these criteria.

The third pillar is the primacy of interest rates as the main tool of monetary policy, set in transparent and predictable ways. For most of this time, the interest rate was a short-term rate closely controlled by the central bank, but the period after the great financial crisis saw central banks "go long" by pursuing policies that would temporarily steer long-term interest rates in government bonds. Throughout, central bankers followed clear principles—like the Taylor rule or gradualism—that made their actions rule-like in allowing the private sector to understand where policy was heading and why.

There are endless debates on whether these three pillars are necessary or sufficient to deliver price stability. But it is unlikely it was a coincidence that inflation was so low and stable in a whole host of countries that followed these same three pillars, at different times and in different circumstances. I raise them because I fear

that in the near future valid criticisms of central bankers' choices in the last year, or understandable outrages at how high and persistent inflation becomes, can lead to overreactions and entirely new regimes that come with volatility and may fail. The last twenty years showed that independent central banks setting interest rates to hit inflation targets can succeed. The water may need some cleaning or some change, but the baby should stay in it.

THE FIRST FACTOR: SHOCKS AND MISDIAGNOSES

The years 2021 and 2022 saw large and unusual shocks hitting the economy. The job of central banks was especially difficult, and choices were made amidst great uncertainty on what the state of the economy was in real time and what the nature and persistence of the shocks affecting inflation were.

The first and major shock was, of course, the pandemic of 2020. At first, it justified a remarkable degree of monetary stimulus since there were legitimate fears of a depression. The Federal Reserve announced a schedule of asset purchases that made its balance sheet expand to a record share of GDP. The ECB gave forward guidance that deposit rates would stay negative extending well beyond one year. Perhaps overinfluenced by the experience of the great financial crisis, many expected long-lasting scars from the COVID recession. Avoiding a slump demanded a strong response.

Instead, the economy rebounded quickly before 2020 was even over. Between the trough in 2020 Q2 and the end of 2021, real GDP rose by 14.9% in the United States and 17.5% in the euro area. The unemployment rate fell by more than 10% in less than twelve months in the United States. Instead of scars and hysteresis, the economy showed an ability to intertemporally substitute production and consumption. After the lockdown of the second quarter of 2020, the economy responded in the third quarter with intense

reopening and economic activity. The private sectors became better at this intertemporal substitution with time, and when a larger health shock came at the end of 2020 with the Alpha wave (in number of infections, deaths, or any other health indicator) together with new lockdowns, the fall in production was smaller for the euro area, and inexistent for the United States. Figure 9.2 shows how quick, relative to its depth, the recovery was in comparison with the other recessions since the start of the century.

Macroeconomic policy deserves credit for this fast recovery. The social insurance programs of 2020 likely contributed to minimizing the scars and prevented consumers from becoming persistently pessimistic and unwilling to work or consume. Almost no bank failed during this time, and there was no significant crisis in any relevant financial market.

At the same time, the recovery came with inflation. The framework of the Phillips curve says that deviation from steady state inflation can come from three direct channels. The first is the expected inflation by households and firms. The second is a deviation of real activity from a potential level of output that is determined by technology and costs. The third is a markup shock that introduces a gap between the potential and efficient levels of output. While different models of price stickiness come with different concrete causes behind each of these three forces, this organizing framework has repeatedly been useful to interpret inflation dynamics arising from shocks.

The fast recovery is an example of the second force driving inflation up. Because tighter monetary policy can work through the same force in the opposite direction, it can stabilize the output gap and inflation with it. However, monetary policy was kept loose in 2021. Additionally, the direct transfers to households and firms in 2020 had led to an accumulation of savings and an explosion in broad monetary aggregates that provided the balances for a boom in spending once the economy reopened. The fiscal stimulus at the start of 2021 in the United States (the American Rescue

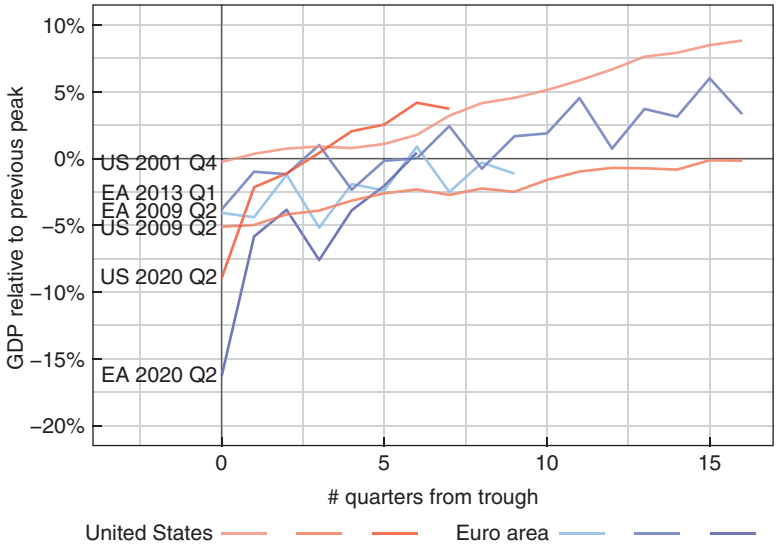

FIGURE 9.2. The Recovery from Recessions in the United States and the Euro Area

Note: Change in real GDP per capita from trough for four years afterwards unless a new peak is reached according to the recession dates of the Centre for Economic Policy Research–Euro Area Business Cycle Network and the National Bureau of Economic Research.

Plan of 2021) further raised aggregate demand, likely to a level above the potential output of the economy. The amount of fiscal and monetary stimulus in 2020 was perhaps excessive, although this judgment comes with the benefit of hindsight. A more pertinent criticism is that policy did not reverse course until at least the end of 2021, even as the signs that the fast recovery was leading to overheating became clearer. This slow reversal is perhaps best explained by the forward guidance given in 2020, serving as a constraint in 2021 on what central banks thought was admissible without defrauding expectations.

A second set of shocks compounded the inflation problem in 2021. They had their origin in the supply sector. At different times during the year, ports became clogged, the production of microchips hit capacity constraints, and global value chains broke down as new waves of the pandemic led to a closing of borders. These

bottlenecks are shocks to the supply of goods in the economy that reflected themselves differently in different countries. Yet, the diagnosis of central banks was similar across the advanced economies. In terms of the Phillips curve, policy makers interpreted all these shocks as temporary markup shocks, the third channel. As such, they concluded that they should not reverse the stimulus stance of monetary policy and not jeopardize the recovery. The standard monetary policy prescription against a temporary markup shock is to let inflation rise above target so that, even if actual output rises above potential, it stays close (or slightly below) the efficient level of output.

This diagnosis was suspect, both at the time and in hindsight. Many of these shocks can just as well be interpreted as shocks to the potential level of output. For instance, the problem with global supply chains affects the actual technology used to produce goods, not just the market power of firms. Moreover, if the shape of globalization is going to change, as some have argued, this will most likely affect the productive capacity of the economy. So, if inflation was rising because of the second channel through lower potential output, as opposed to the third through higher deviations from the efficient level of output, the policy prescription would be instead to tighten monetary policy and to keep inflation on target. Simply put, persistent and recurrent negative supply shocks to potential output will make the economy poorer: inflation cannot change this, nor can monetary policy.

Energy prices were the third shock. They had been rising since 2021, and sharply increased in 2022 with the Russian invasion of Ukraine. The ECB responded again as if this was a temporary markup shock, as opposed to a shock to potential output. Policy tolerated a sharp increase in inflation, predicting it to be short lived. It was a defensible priority to strive to avoid mistakes of the past, when hikes in oil prices would raise inflation, trigger tighter monetary policy, and cause a recession.

Yet this "see through the shock" policy is a prescription of the literature only if inflation expectations are anchored. Otherwise, the

sharp increase in the prices of energy will have an oversize impact on household expectations as the first channel of the Phillips curve becomes operative, further pushing inflation up. Not only did central banks again interpret a supply shock as being a shock to markups, as opposed to potential output, but they relied on expectations being anchored. Yet, large changes in household costs of energy are salient to households and can easily unsettle their expectations.

Three times in a row in a short period of time, a set of shocks pushed inflation up. Three times in a row, monetary policy interpreted them using the lenses of the Phillips curve in the direction that concluded that monetary policy should be kept loose. Three times in a row, this diagnosis was plausibly right but disputable, and the risk was that inflation would rise too much and too persistently. After the fact, in all three cases this risk became reality. A policy framework should be robust to shocks, and it should correct misdiagnoses. So many successive errors in the same direction indicate more systematic problems. The next three factors point to three such problems.

THE SECOND FACTOR: EXPECTATIONS

No central banker would deny the importance of inflation expectations for the control of inflation. Over the last decade, expected inflation was very sticky, so that its measurements reflected mostly noise with little signal. Household surveys of inflation expectations invariably returned an answer of 2%, which in every wave was polluted by measurement error. Only through careful econometric work were researchers able to uncover interesting patterns that allowed for scientific progress in understanding expectations and inflation. In turn, data from financial markets likewise reflected mostly changes in risk attitudes as well as financial shocks, which introduced noise beyond the expected inflation signal. Inflation expectations were solidly anchored because of the success of the

past. Staffers at the forecasting team of central banks were justified in ignoring expectations data in their econometric models (Coibion, Gorodnichenko, and Kamdar 2018).

The experience of 2020 confirmed this view. Despite a few months of sharp deflation, followed by sharp month-to-month inflation, expectations of inflation stayed remarkably stable. The trust that central banks placed in the anchor is evident in the speech by Jerome Powell at the August 2021 Jackson Hole Economic Policy Symposium. The speech discusses data from inflation expectations and concludes that: "Households, businesses, and market participants also believe that current high inflation readings are likely to prove transitory and that, in any case, the Fed will keep inflation close to our 2 percent objective over time." (Powell 2021). There was nothing to see, and the anchor was firmly in the seabed.

In fact, before inflation started rising, central bankers were mostly worried about the possibility that expectations might be anchored at levels of inflation that were too low. In the presentation of the Federal Reserve's new framework in the 2020 Jackson Hole speech, Powell discussed the problem of an "adverse cycle of ever-lower inflation and inflation expectations." (Powell 2020). The ECB, in its revised monetary policy statement wrote: "In particular, when the economy is close to the lower bound, this requires especially forceful or persistent monetary policy measures to avoid negative deviations from the inflation target becoming entrenched." (European Central Bank 2021).

Relying on anchored inflation expectations and focusing on the downside risk has consequences for monetary policy. First, with expected inflation equal to a constant in the Phillips curve framework, one of the main drivers of inflation is absent. Second, a temporary rise in inflation expectations is welcome. If the fear is that of a deflation trap, then a rise in inflation expectations is a way to escape the adverse cycle in the Powell quote above. Third, a rise in actual inflation is likely to be transitory. If expectations stay anchored, they

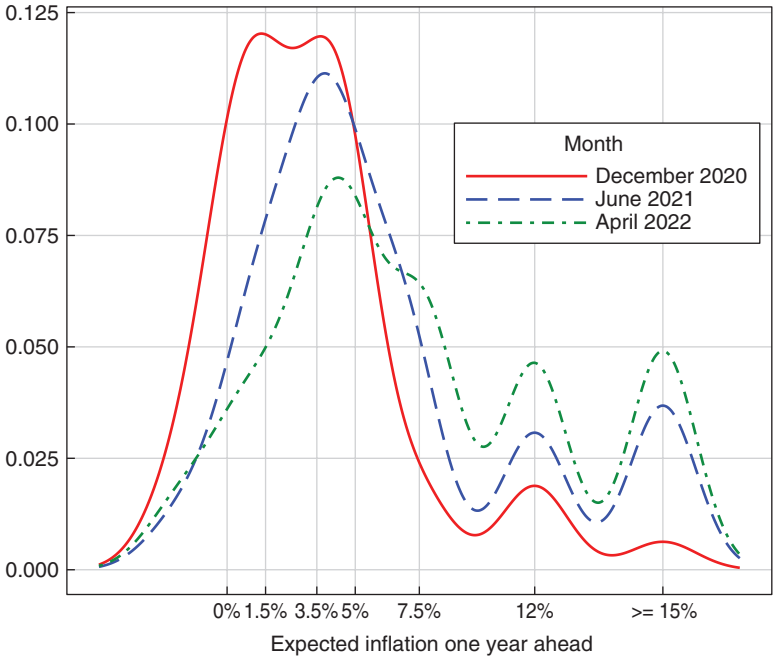

FIGURE 9.3. The Distribution of US Household Survey Inflation Expectations through 2021–22

Note: Data from the University of Michigan Surveys of Consumers, household expectations for one-year-ahead expected inflation.

pull inflation towards them, making most inflation shocks temporary. These three consequences are interlinked: If expectations are solidly anchored, then even sharp rises in inflation will only move them up a little, with no risk that the anchor would go adrift.

However, already halfway through the year 2021, the data showed that expectations were not so well anchored. In line with modern research, the key was to look beyond the measure of central tendency from household surveys and to focus on measures of disagreement. Figure 9.3 shows three snapshots of the distribution of one-year-ahead inflation expectations in the University of Michigan Surveys of Consumers household expectations. In the

first half of 2021, the skewness started rising. That is, a rising share of households started expecting that inflation would be higher, even as the median changed little. Then, it was the standard deviation that rose decisively as more and more households joined the group of pessimists. By 2022, the shift of the distribution to the right was such that the median was rising quickly as well.

This three-stage movement in the distribution of expectations is not unique to 2021–22. Looking back to the end of the 1960s in the United States, again the distribution of survey inflation expectations shifted slowly to the right, and this was seen first through an increase in skewness, then a rise in standard deviation, and finally the rise in the median (Reis 2022a). This process took a few years back then, as opposed to less than one year in 2021–22, but qualitatively it was similar. In the other direction, between 1980 and 1985, as inflation sharply came down, again it was first skewness, then standard deviation, and finally median that moved as the distribution shifted to its new anchor. Another common feature of these three episodes is that the surveys of professionals lagged those of households, and after the fact turned out to be the more sluggish and less informative source of data. In normal times, the opposite happens, as household survey data lags professional surveys and is less accurate, but during these three past large changes in inflation, household data was more informative.

The data in 2021 revealed that a large change in expectations was under way. The expectations anchor had left the seabed after a couple of decades during which it had barely moved. Perhaps this was the result of the shocks that hit the economy, or perhaps it was a result of the loose monetary policy that accompanied them. Bad luck played a role, as some of the relative prices that moved the most in 2021 (like gas prices or cars) were among those most visible to consumers, who will tend to overreact to them when forming their expectations. Once central banks allowed inflation to rise, those realizations themselves fed into households anticipating higher

expected future inflation. A temporary inflation shock becomes persistent if the expectations anchor moves with it.

THE THIRD FACTOR: CREDIBILITY

Sharp movements in expected inflation over the next year are alarming for the persistence of the shock. But if expectations of the distant future continue to be stable, the damage for inflation will be limited. The credibility of an inflation-targeting central bank is ultimately measured by whether expected long-run inflation is equal to its target. In the long run, money is neutral, the Phillips curve is (nearly) vertical, and expected inflation matches actual inflation. If the central bank manages to convince economic agents that inflation in the long run will be on target, then most of the work of keeping its actual value on target in the long run will have been done.

In 2021, it was justified to rely on having significant credibility. After all, such credibility had been earned after more than twenty years of inflation very close to 2%. Central banks can enjoy a "capital of inattention" in that people do not pay much attention to what the central bank is doing, trusting it will deliver inflation on target over the next few years. One important consequence of this credibility is that it will make the negative relation between inflation and real activity appear to be flatter. As people and firms are inattentive, and update their wages and prices less often, the extent of nominal rigidities in the economy rises, making monetary policy more powerful in affecting real activity. Relying on this credibility, the central bank can exploit short-run trade-offs between inflation and real activity to try to improve welfare. Policy makers will appear more "dovish" because mistakes in policies are more likely to cause recessions than to cause high inflation. In 2021, facing an unusual amount of uncertainty about the shocks hitting the economy and their ability to measure fast-moving indicators, central banks leaned heavily on their credibility by allowing inflation to rise above target to offset the impact

of these shocks on real activity. As long as they had credibility, inflation would only rise moderately.

It is hard to survey households on what they expect inflation to be in the distant future. Instead, the dominant measure of credibility comes from financial markets. The most used measure is the 5-year, 5-year forward inflation expected rate. Using either inflation swaps or nominal and inflation-indexed bonds over 5- and 10-year horizons, it computes what the expected inflation will be starting in five years, on average over the succeeding five years. Looking at April 21, 2020, 2021, and 2022, this measure increased from 1.34% to 2.13% and then to 2.67%, respectively, in the United States. Since market measures include a premium for inflation risk, even the more recent number is maybe only slightly above a 2% inflation target.

However, again the average hides what is behind it in the distribution. Looking beyond the mean gives more cause for alarm. Recent research has developed methods to use option prices to inspect these distributions and, especially, to accurately capture the probabilities of the tails (Hilscher, Raviv, and Reis 2022). The top panel of figure 9.4 shows these distributions for the 10-year horizon in the United States throughout 2021. While the average rose little, there was a clear shift to the right. Especially during the second half of the year, this shift came with a quick accumulation of mass on the right tail. The distributions became increasingly asymmetric as upside risks to inflation became dominant.

The bottom panel of figure 9.4 focuses on that right tail by presenting probabilities that reflect how much market participants are willing to pay to insure themselves against an "inflation disaster," a scenario where inflation is persistently higher. To do so, these estimates adjust the tails from the top panel to take out the compensation for risk, and they set the horizon to 5-year, 5-year so as to focus on credibility, as opposed to pessimism about the immediate few years. The numbers therefore measure the current date market-perceived probability that average inflation will be more than 4%

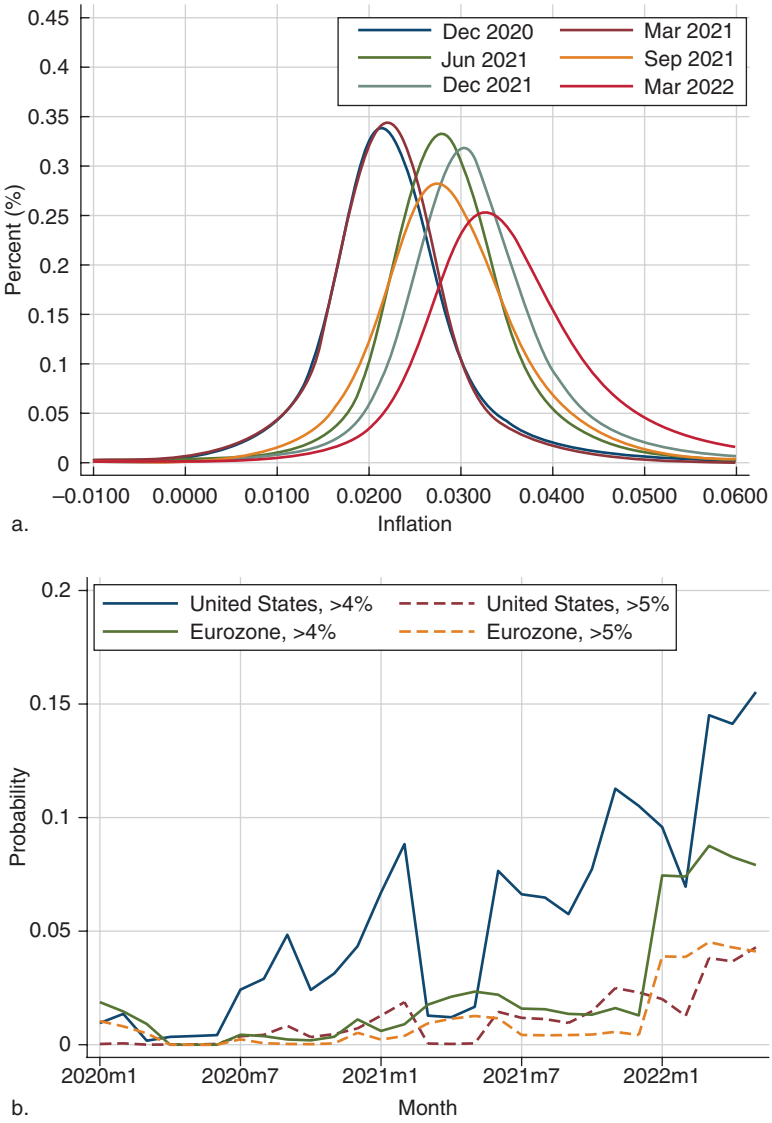

FIGURE 9.4. Measurements of Credibility of the Federal Reserve from Options Markets

a. Probability densities for average risk-adjusted inflation over the next ten years
b. Tail probabilities of a 5-year, 5-year inflation disaster in US and EZ inflation

Notes: Estimates using the methods in Hilscher, Raviv, and Reis (2022). The top panel shows 10-year distributions including risk premia. The bottom panel shows actual forward probabilities over a 5-year, 5-year horizon.

starting in five years, over the following five years. If central bankers are risk managers, they should care more about these disasters than about the average outcome that was so often cited in 2021.

In the United States, this probability rose steadily from the middle of 2021 onwards. By the last date in this sample, April of 2022, it was 16%. Investors were paying a high price to insure against the chance that the Federal Reserve would, considerably and persistently, miss its inflation target between 2027 and 2032. This reveals a lack of credibility of the Federal Reserve. Credibility in the inflation target of the ECB stayed high until the end of 2021. But then, the perceived disaster probability jumped up very quickly to 8%. This is less than in the United States, but it still puts a considerable dent into the faith that credibility has remained intact.

Seeing these numbers, relying on credibility of the inflation target to offset policy shocks by letting inflation rise is a bold and risky move.

THE FOURTH FACTOR: R-STAR AND THE TOLERANCE OF INFLATION

In 2019, both the Federal Reserve and the ECB announced they would be revising the framework that guides their monetary policies. When presenting the result of this work at the 2020 Jackson Hole conference, Jerome Powell cited as one of its important motivations the "fall in the equilibrium real interest rate, or 'r-star.'" In turn, in the overview document that the ECB released presenting its own reviews, the first justification offered for why it was needed was that "structural developments have lowered the equilibrium real rate of interest."

This r-star refers to the real interest rate at which savings are equal to investment and output is at its potential. It is often interpreted and measured as the long-run steady state for real returns in the economy. Sometimes it is called the neutral rate of interest

because, in New Keynesian models, having the nominal interest rate of the central bank above r-star plus the inflation target captures contractionary policy. Conversely, if the policy rate is below r-star plus 2%, then policy is understood to be expansionary, putting upwards pressure on inflation. R-star is difficult to estimate because it is observed in an equilibrium that is never reached but estimates that show it has fallen make it more likely that monetary policy is contractionary for any given level of the policy rate.

If r-star is indeed lower, it is more likely that when the central bank needs to lower policy rates aggressively to push up inflation, it will find itself unable to do so. It would require policy rates that are below their "effective lower bound" (ELB). Therefore, monetary policy will sometimes be insufficiently expansionary. In principle, this would lead to too little inflation. The central bank can "go long," trying to affect longer-term interest rates by using forward guidance and quantitative easing to provide further expansion, but this may not be enough.

Matters can get worse. If agents start expecting deflation, and the central bank cannot lower interest rates, then this breakdown of the Taylor principle because of the ELB makes deflation self-fulfilling. As Powell's 2020 speech noted, in that case, the economy may enter an "adverse cycle of ever-lower inflation and inflation expectations," leading the economy to become stuck in a deflation trap. A long academic literature suggests that, to escape this trap, central banks must find a way to commit to delivering high inflation, above the target, in the future. Future higher inflation would boost current inflation, and on average deliver inflation on target.

An emphasis on a low r-star also leads to a focus on providing stimulus to aggregate demand. In economies at the ELB, aggregate demand is too low. The economy is persistently operating below capacity, so that the looser monetary policy can be, the better. This logic extends to fiscal policy, and thus to embracing large deficits and to not worrying about the public debt (which, anyway, now

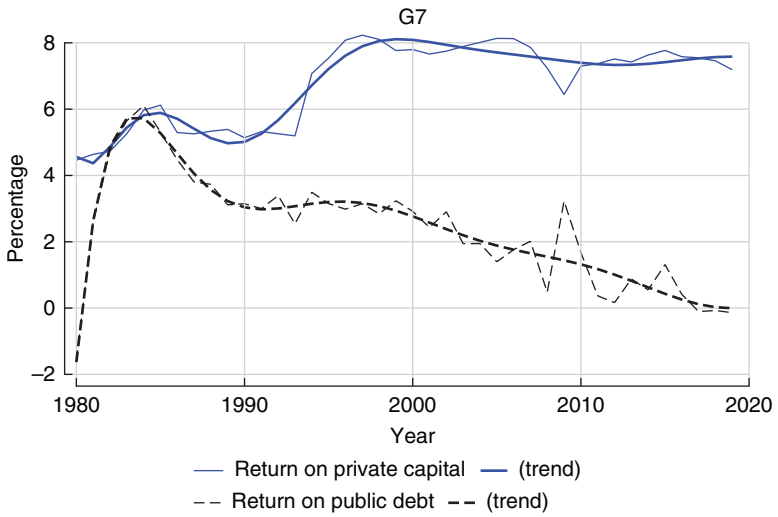

FIGURE 9.5. Estimates of R-star from Returns on Government Bonds and on Private Capital

Note: Estimates from Reis 2022b.

pays a lower interest rate). Policies based on supply, in contrast, are less important. At the ELB, the opportunity cost of liquidity is close to zero, so firms should have access to abundant liquidity and credit. Improvements in aggregate productivity may even backfire and lower output if they lower inflation expectations.

Putting it all together, if r-star has fallen, then central banks increasingly start to worry about deflation because of inevitably tight monetary policy even with interest rates near zero. They welcome inflation rising above target, and they focus on perpetually boosting real activity and providing more and more stimulus. Both the Federal Reserve and the ECB's mission reviews moved in this direction. But has r-star fallen?

Figure 9.5 shows that the ex post return on long-term government bonds has fallen in the G7 countries over the last twenty or thirty years. Short-term government bond yields were close to the ELB for many years including 2021. Monetary policy was

certainly constrained in providing more stimulus. But the theoretical concept of r-star refers to an equilibrium between savings and investment in the overall economy. Why would this happen in the government bond market? In fact, in the standard neoclassical growth model that defines the output potential in many modern macroeconomic models, the interest rate on government bonds is irrelevant, as government bonds are not net wealth. It is the marginal product of capital (and time preferences) that determine where savings equal investment. The return on government bonds is only useful because with efficient and complete capital markets, it provides a risk-free measure of the relevant r-star, which conceptually is the return to capital in the economy.

Closer to the concept of r-star is to measure the return on investing in the private capital stock. Doing so using financial returns is a thankless task because, as the Modigliani-Miller theorem states, the return on capital can be split in many ways between different financial claims, and these have likely changed over time. Instead, figure 9.5 shows a measure of the return to capital using the income flows in the aggregate economy. Namely, it starts with value added in the economy, subtracts payments to labor and depreciation, and divides it by the private capital stock. It is therefore a measure of the average return from owning capital in the economy every year, whether those came from profits or costs of finance, or from the payout of loans, bonds, dividends, or others. This measure of r-star has been remarkably constant over the last twenty years. There is no downward trend in it.

There has been a trend increase in the difference between the return in the private economy and the return on government bonds. Perhaps this is a sign of misallocation of capital away from private investment in the capital stock and towards financial investments. It may also reflect an inability of capital markets to fund enough investment to bring the marginal product of capital down. Or, perhaps it reflects an increasing "specialness" of government

bonds in providing safety, liquidity, convenience, or some other service that attracts an excess demand for them and justifies their paying an inferior return. Whichever it is, the data suggest that r-star may have been constant, or it may have fallen, but the difference between private and public returns has definitely risen.

This perspective—nondecreasing return to private capital and an increasing wedge between it and the return on public debt—changes the focus of monetary policy (Reis 2022b). First, promising to increase inflation in the future to raise inflation expectations becomes less appealing. Doing so still lowers the real interest rate on government bonds and boosts consumption at the ELB, so it is still an effective policy. However, now it only raises investments if it can reduce the real return on the private capital stock, which it may or may not be able to do. Therefore, all else being equal, it is likewise less stimulative. The costs of higher inflation may start offsetting its benefits.

Second, and related, the priority of escaping the ELB is no longer as overwhelming. Policies that raise the r-star measured with government bonds may relax the constraint on monetary policy. But if these policies do not close the gap to the return on private capital, or even raise the r-star measured with private capital, then they may backfire. They will crowd out investment and potentially lower real activity.

Third, to exit a situation of a persistent deflation trap and accompanying stagnation, lowering the gap between the return on private capital and the return on the public debt is an alternative strategy. This logic points to working on the supply side of the economy, focusing on what is disturbing the allocation of savings. It gives a different focus to the one underlying the recent mission reviews with their focus on aggregate demand. It instead leads to thinking harder about how financial regulation may be helping or hindering an effective allocation of capital, or to what extent asset purchases by central banks have aided or distorted the allocation of capital, to give two examples.

Finally, lower interest payments on the public debt allow for a higher level of public debt to be sustainable. But, if the source of these lower payments is a rising gap between the return on private capital and the return on government debt that is induced by the specialness of public debt, then monetary policy should ask how it contributed to that specialness. In particular, the remarkable achievement in stabilizing inflation over the last twenty years may be related to that rising gap. It has meant that one of the major risks in lending to the government, which is inflation, has disappeared. This suggests that if higher inflation comes with more volatile inflation, and hence higher inflation risk premia, then this may well close the gap between the two rates of return by raising the return that bondholders require on public debt. This would hurt debt sustainability. Delivering on the mandate of price stability becomes even more important (Reis 2022c).

CONCLUSION

The rise in inflation in 2021–22 is such a dramatic event that it will likely spur a large literature and a heated debate in trying to explain it over the next many years. Perhaps it may even trigger regime changes in how monetary policy is conducted. In the short run, it is surely leading to changes in policy to bring inflation back on target.

This article made some contributions to this analysis. It started by reminding that the institutional regime that is in place today, based on independent central banks with inflation targets that set interest rates predictably, has served the advanced economies very well over the previous thirty years. It seems unwise to throw it out after one year of high inflation.

Second, it put forward four structural causes for why inflation rose so much. Common to all of them is a presumption that if inflation rises, it is because the central bank allowed it to rise. Every year has its shocks hitting the economy and its challenges for central banks.

The past always seems rosier in comparison with the turmoil of the present. But theoretically, the institutional regime described above is predicated on the principle that ultimately the central bank can always use its tools to rein in inflation around its target on average over a few years. When the central bank allows inflation to deviate significantly from target in the short run, it is by choice, in trading off other objectives. Empirically, over the last two decades, dozens of countries all over the world adopted this institutional regime under all kinds of circumstances and facing all types of shocks. Almost all and almost always they were able to deliver low and stable average inflation.

The first of the causes for the failure this time was that the unusual and large shocks of 2020–22 were almost always diagnosed in a way that justified keeping monetary policy extremely loose. The fast recovery of 2021 was not enough to trigger a quick reversal on previous forward guidance since the focus was on real activity. The succession of supply shocks was all interpreted as temporary markup shocks as opposed to persistent changes in potential output. As a result, purposely allowing inflation to overshoot its target was seen as optimal and desirable. That is, until it became too large to justify.

The second cause was a steadfast belief that inflation expectations would stay anchored, as they had been for two decades. This belief led to relying on surveys of professionals and on the median expectation of inflation from household surveys to support this strong prior. The distribution of survey inflation expectations and the historical experience with regime shifts pointed elsewhere already in the second half of 2021, and this became clear in 2022. Missing the drift of its anchor, central banks underestimated the persistence that the deviations of inflation from target would have.

The third cause was an overreliance on the credibility of monetary policy. The capital of inattention that the central bank had earned in the past would have allowed it to focus on real activity or other parts of its mandate during an uncertain time. Yet, either by bad luck or by leaning too hard on this past credibility, some of

it was lost, producing an upward spiral of inflation when output rose above potential.

The fourth cause was the influence of estimates of a falling and low r-star in the revision of the frameworks for monetary policy. These led to a determination to fight low inflation, and an increased tolerance for inflation above target, as well as a focus on stimulating the economy through aggregate demand. When inflation started rising, this contributed to not fighting it as vigorously as otherwise might have been the case. The r-star that comes from private returns has been constant, and the rising gap between those returns and those on public debt suggest that a different set of policies might have been warranted.

This paper proposed these causes as hypotheses. While there is a strong case that they played a role, future research will tell if they were quantitatively the most relevant. For now, facing the challenge of bringing down inflation, they suggest that policies in the near term may involve: (i) accepting lower levels of real activity in the future, (ii) acting vigorously and sharply in the near future with raising interest rates to reanchor expectations, (iii) restating as loudly and convincingly as possible the primacy of price stability as the goal that guides policy, and (iv) revising upwards the relative costs of high inflation while refocusing on aggregate supply policies.

References

Coibion, Olivier, Yuriy Gorodnichenko, and Rupal Kamdar. 2018. "The Formation of Expectations, Inflation, and the Phillips Curve." *Journal of Economic Literature* 56: 1447–91.

European Central Bank. 2021. "An Overview of the ECB's Monetary Policy Strategy," July 8. Available at: https://www.ecb.europa.eu/home/search/review/html/ecb.strategyreview_monpol_strategy_overview.en.html.

Evans, Charles. 2011. "The Fed's Dual Mandate Responsibilities and Challenges Facing US Monetary Policy." Speech at the European Economics and Financial Centre, London, September 7. Available at: https://www.chicagofed.org/publications/speeches/2011/09-07-dual-mandate.

Hilscher, Jens, Alon Raviv, and Ricardo Reis. 2022. "How Likely Is an Inflation Disaster?" CEPR discussion paper 17224.

Miles, David, Ugo Panizza, Ricardo Reis, and Ángel Ubide. 2017. *And Yet It Moves: Inflation and the Great Recession*. Geneva Reports on the World Economy 19, CEPR Press.

Powell, Jerome. 2020. "New Economic Challenges and the Fed's Monetary Policy Review." Speech at the 2020 economic policy symposium in Jackson Hole, Wyoming, August 27. Available at: https://www.federalreserve.gov/newsevents/speech/powell20200827a.htm.

———. 2021. "Monetary Policy in the Time of COVID." Speech at the 2021 economic policy symposium in Jackson Hole, Wyoming, August 27. Available at: https://www.federalreserve.gov/newsevents/speech/powell20210827a.htm.

Reis, Ricardo. 2022a. "Losing the Inflation Anchor." *Brookings Papers on Economic Activity*, forthcoming.

———. 2022b. "Has Monetary Policy Cared Too Much about a Poor Measure of R*?" Unpublished manuscript, presented at the Asian Monetary Policy Forum, May.

———. 2022c. "Steady Prices, Sustainable Debt." *Finance and Development* 59, no. 1 (March): 16–19.

DISCUSSANT REMARKS

Volker Wieland

In this chapter, Ricardo Reis comes to the conclusion that central banks—in particular the Fed and the European Central Bank (ECB)—could have acted earlier to slow down the rise in inflation but failed to do so. He identifies signals from the data on inflation, household expectations, financial market derivatives, and the returns on private capital that became visible in the first half of 2021 and strengthened throughout the year. In his view, four factors contributed to the delayed response of the central banks: (1) a misreading of relevant shocks; (2) insufficient attention to a rise in household expectations; (3) ignorance of signals of a loss of credibility in long-dated inflation swaps and inflation-indexed bonds, including implied tail probabilities; and (4) excessive focus on low equilibrium interest rate estimates derived from government bonds rather than private capital.

I share Reis's assessment that the Fed and the ECB could have, and should have, responded earlier by tightening monetary policy. Furthermore, I largely agree that the four factors he discusses played an important role in the policy debate and in central banks' decision making. In the following discussion, I provide additional perspectives on these and other factors that mostly support the case he makes, and I note a few caveats. In so doing, I discuss implications of the literature on monetary policy under uncertainty regarding some of the strategic and tactical choices made at the Fed and the ECB.

THE PATH OF INFLATION AND CENTRAL BANK ASSESSMENTS

In the United States, the consumer price index (CPI) inflation rose from 0.24% in May 2020 (percentage change from a year ago) to about

1.3–1.4% between September 2020 and January 2021. Then it quickly increased further to 2.7% in March 2021, 5.3% by June 2021, 6.2% by October 2021, and 7.1% by December 2021. As of May 2022, US CPI headline inflation reached 8.6%. The personal consumer expenditures (PCE) deflator series, which the Fed primarily focuses on, rose more or less in parallel from 0.4% in April 2021 to 6.4% in April 2022.

Reis correctly emphasizes that for a longtime policy makers stuck to the view that the rise of consumer price inflation was a temporary phenomenon that would subside fairly quickly. For example, according to CNBC, Chicago Federal Reserve President Charles Evans said on October 5, 2021, that the Fed soon will be facing the familiar charge of keeping inflation elevated to healthy levels, and likely will have to keep rates low. As late as November 18, 2021, Reuters reported that he said monetary policy is in a "good place," and that he still "believes currently high inflation will recede next year and end 2022 closer to 2% than many people think," allowing the Fed to stay patient on policy.[1] Other members of the Federal Open Market Committee (FOMC) voiced similar views throughout the summer and fall of 2021. As a consequence, most FOMC members saw little reason to raise the federal funds rate in 2022. As of September 2021, the central tendency regarding the anticipated value of the federal funds rate at the end of 2022 still stood at 0.1% to 0.4%.

In the euro area, inflation as measured by the harmonised index of consumer prices (HICP) was negative in the last few months of 2020. In January 2021, it moved to 0.9% from –0.3% in December 2020. From then on, it rose rather quickly: 1.3% in March 2021, 1.9% in June, 3.4% in September, 5.0% in December, and 5.4% in February 2022. Following the start of the Russia-Ukraine war, it rose further, reaching 7.4% by April 2022. Currently, it's estimated at 8.1% for May 2022.

1. Jeff Cox, "Fed's Evans Sees Inflation Falling below Central Bank's 2% Target after Current Rise Subsides," CNBC, October 5, 2021; and "Fed's Evans: Baseline View Is for 2023 Rate Hike, but 2022 Possible," *Reuters*, November 19, 2021.

As noted by Reis, policy makers at the ECB also stuck to the characterization of the 2021 rise in inflation as a short-lived phenomenon for a long time. To give an example, ECB board member, Isabel Schnabel, when asked on November 29, 2021, by the German TV channel ZDF how much longer the rise in inflation was going to last, responded: "Many people were not expecting prices to increase to this extent. But we believe that the inflation rate will peak in November and gradually subside next year, towards our inflation target of 2%. Indeed, most forecasts expect inflation to fall even below that 2% level. So, there is no indication that inflation is getting out of control."[2] With her assessment, Schnabel was by no means an outlier among the members of the Governing Council. Nor did it deviate from the ECB staff's projection. Only on December 16, 2021, did the euro system staff raise its inflation projection for 2022 to 3.2%, up from the ECB staff's projection of 1.7% in September 2021. This has been the ECB's largest inflation forecast revision to date.

OUTPUT GAPS, TEMPORARY COST-PUSH SHOCKS, AND INFLATION PERSISTENCE

Reis starts by arguing that central banks underestimated the inflationary impact of the rapid recovery following the pandemic and recession in 2020 with demand exceeding supply and driving up inflation. He also suggests that the impact of the inflationary shocks due to bottlenecks that arose in international sourcing and intermediate goods, as well as those due to energy prices, were misdiagnosed. Central banks characterized them as temporary cost-push shocks. They followed the presumably "conventional wisdom" that monetary policy should look through these shocks and the central bank should let inflation rise while keeping output close to the (unchanged) potential.

2. "Interview with Isabel Schnabel, Member of the Executive Board of the ECB, conducted by Mitri Sirin on 29 November 2021," European Central Bank, November 29, 2021.

Additionally, they thought inflation would be self-stabilizing and soon return to the credible inflation target of the central bank.

According to Reis, this was a misdiagnosis. Instead, these shocks can also be understood as negative productivity shocks that reduce potential output. As a result, aggregate demand exceeds potential output and pushes up inflation. In this case, the standard monetary policy prescription would have been to tighten monetary policy to bring demand back in line with potential output.

I agree that such a misreading of the impact of the shocks may well have been a reason for the inaction of the Fed and the ECB. However, I want to move beyond the point raised by Reis and question the wisdom of "looking through" cost-push shocks. In particular, it relies too much on a low degree of inflation persistence and a high degree of credibility for the central bank's inflation target.

To this end, it is helpful to consider simulations of a standard small New Keynesian model. I use the model developed by Clarida, Galí, and Gertler (1999), which embodies much of New Keynesian "conventional wisdom."[3] It consists of a forward-looking aggregate demand curve, a forward-looking Phillips curve, also mentioned by Reis, and an interest rate rule for monetary policy. An extended version of the model also includes lagged output in the aggregate demand curve and lagged inflation in the Phillips curve. This extended Phillips curve corresponds to:

(1) Extended Phillips curve:
Inflation = φ past inflation + $(i - \varphi)$ expected future inflation
+ λ output gap + cost-push shocks

Compared to the Phillips curve discussed by Reis, the extended Phillips curve uses past inflation as an additional element. The

3. The model is one of 150 models available at our Macroeconomic Model Data Base, https://www.macromodelbase.com. The simulations shown can easily be reproduced with software we have made available online. For further information, see also Wieland et al. (2016).

parameter φ lies between 0 and 1 and regulates the importance of inflation persistence. With $\varphi = 0$, equation (1) corresponds to the simplest version of the New Keynesian Phillips curve.

To investigate the consequences of a monetary policy that "looks through" the inflationary impact of cost-push shocks, I compare the well-known Taylor (1993) rule with a version of the rule that assigns an eight times larger reaction coefficient on the output gap. With a reaction coefficient of 4 instead of 0.5, what is referred to below as the "accommodative rule," aims much more aggressively towards stabilizing aggregate at potential in the event of macroeconomic shocks, than the original Taylor rule. The parameter r^* stands for the equilibrium real interest rate while π^* refers to the inflation target.

(2) Taylor (1993) rule:

$$\text{fed funds rate} = r^* + \text{inflation} + 0.5\,(\text{inflation} - \pi^*) \mathbf{+ 0.5\ output\ gap}$$

(3) Accommodative rule:

$$\text{fed funds rate} = r^* + \text{inflation} + 0.5\,(\text{inflation} - \pi^*) \mathbf{+ 4\ output\ gap}$$

I start by simulating a positive cost-push shock in the purely forward-looking New Keynesian model ($\varphi = 0$) under these two policy rules. As shown in the first panel of the top row of figure 9.6, the shock pushes inflation up by close to 1 percentage point. The Taylor (1993) rule (blue line) keeps inflation a bit lower—by about 20 basis points—than the Taylor rule accommodated (red line). But in both cases, inflation collapses within four quarters. This is an example of the purely temporary impact that the Fed and ECB were anticipating. Of course, the Taylor (1993) rule raises the federal funds rate quite a bit while the accommodative rule moves it much less (middle panel, top row). As a result, the Taylor rule opens up a much bigger negative output gap (right panel, top row).

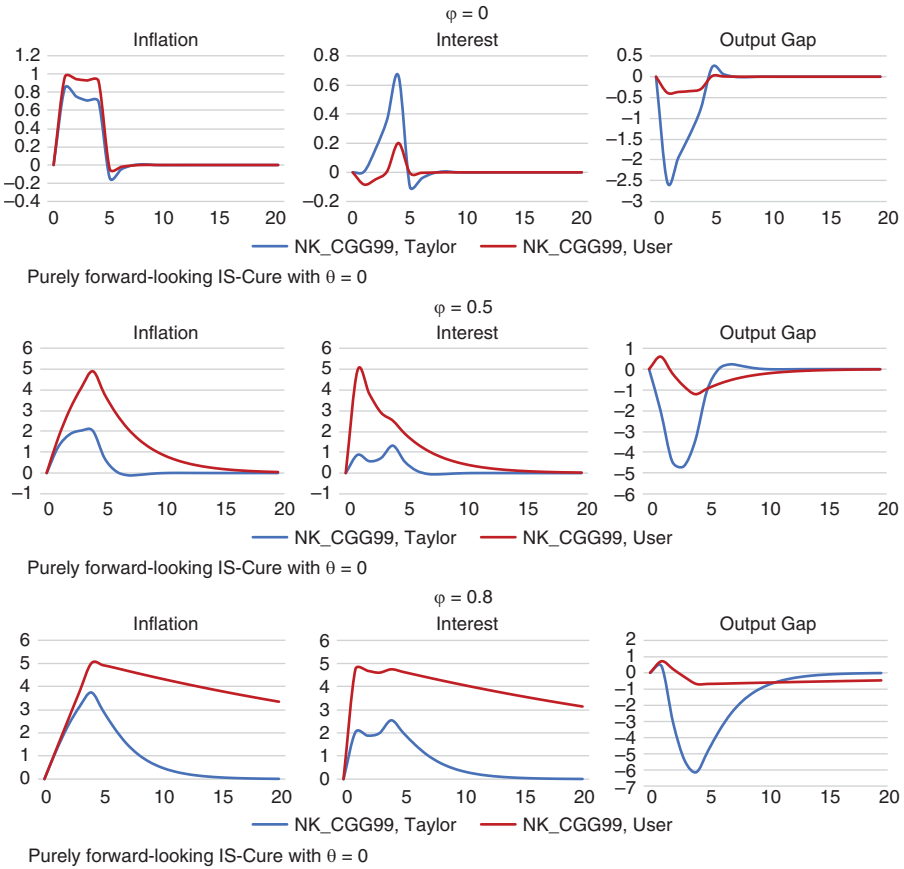

FIGURE 9.6. Simulation of a Positive Cost-Push Shock in a Forward-Looking New Keynesian Model

Source: Author's calculations using the Macroeconomic Model Data Base, https://www.macromodelbase.com.

The trade-off between the output gap and inflation stabilization is clearly unfavorable. This confirms the conventional wisdom of looking through a temporary cost-push shock.

However, once there is a significant degree of inflation persistence, the picture changes drastically. When lagged inflation receives the same weight as expected future inflation ($\varphi = 0.5$, middle row in figure 9.6), the cost-push shock leads to substantial increase in

inflation of up to 5 percentage points under the accommodative rule relative to 2 percentage points under the Taylor (1993) rule. For this reason, the accommodative rule ultimately needs to raise the funds rate much more than the Taylor rule to rein in inflation.

In a situation where inflation depends more on past inflation than inflation expectations ($\varphi = 0.8$, bottom row in figure 9.6), the cost-push shock drives inflation up for more than 5 years under the accommodative rule. These simulations assume that the inflation target of the central bank is 100% credible. This ensures that even in the simulation with high inflation persistence, real rates need not rise much to return inflation to its target eventually. In practice, however, a sustained rise in inflation raises doubts about the central bank's commitment. Thus, inflation expectations will become unhinged, and the central bank will lose control of inflation.

Bottom line: When faced with cost-push forces and uncertainty about inflation persistence, the central bank better react right away rather than wait and "look through" the rise in inflation.[4] And it may need to accept inducing a negative output gap to achieve price stability.

INFLATION EXPECTATIONS, ASYMMETRIC RISKS, AND CENTRAL BANK POLICY

Reis argues that central bankers remained mostly worried with the possibility that expectations might be anchored at too low of an inflation rate and failed to act while it became clear in 2021 that a substantial change in expectations was under way. Looking at the distribution of US household inflation expectations one-year ahead from the University of Michigan Surveys of Consumers, he shows a three-stage movement. In the first half of 2021, skewness was rising

4. Söderström (2002) shows that parameter uncertainty about the persistence of inflation calls for a more aggressive policy response, in contrast to the finding that multiplicative parameter uncertainty calls for gradualism (Brainard 1967; Wieland 2006).

already, resulting in a longer tail on the upside. As more and more households expected higher inflation, the standard deviation rose and eventually, so did the median.

Reis's findings for US household expectations are certainly thought-provoking. With regard to the euro area, I would like to draw attention to the Bundesbank's survey of household inflation expectations in Germany. It also provided a signal of what was ahead. Throughout 2021, this survey reported an increasing share of households expecting inflation to increase slightly or significantly over the next twelve months. By May 2021, the median also moved up from 2% to 3%. By October 2021, it had reached 4%.

An interesting recent paper by Dräger, Lamla, and Pfajfar (2022) reports on a randomized control trial (RCT) that was included in the September 2021 survey. They randomly exposed households to different information treatments such as (1) the current August 2021 inflation rate of 3.6%; (2) the inflation projection from the survey of professional forecasters; (3) a newspaper report from May 31, 2021, stating that ECB president Lagarde had "so far stressed that she thinks the increased inflation will be a temporary phenomenon"; and (4) a newspaper report from March 12, 2021, stating that Volker Wieland, member of the German Council of Economic Experts had said: "I think it's possible that we'll have similar inflation rates also in 2022 and the years after, that are between 2% and 3% annually." Interestingly, Dräger, Lamla, and Pfajfar find that communication using explicit numerical inflation projections limited spillovers from the current inflation rate to inflation expectations.

How should monetary policy account for asymmetric risks? According to the basic inflation forecast targeting framework, the central bank should only respond to the point forecast. Standard deviation and asymmetry of the inflation distribution are ignored. This policy prescription is derived in a framework with a linear economy, known parameters, normally distributed shocks, and a quadratic central bank objective function (see Svensson 1997). By contrast,

distributions matter for policy once the framework is extended to allow for a nonlinear economy, non-quadratic objectives, non-normal distributions, and parameter uncertainty. In particular, non-normal errors and skew call for a more aggressive policy reaction according to Swanson (2000) and Christodoulakis and Peel (2009).

In this context, I would also like to point out an asymmetry introduced explicitly in the recent update of the FOMC's monetary policy strategy. It clarified that the Committee seeks, over time, to mitigate shortfalls of employment from the Committee's assessment of its maximum level. This strategy does not include a symmetric response when employment exceeds its natural or long-run level. This asymmetry in policy response to the unemployment gap is also made explicit in the balanced-approach (shortfalls) rule that was included in the July 2021 *Monetary Policy Report* to illustrate the FOMC's approach.

Interestingly, such an asymmetry in the monetary policy objective has been the focus of several contributions to the literature on optimal monetary policy (see Tambakis 1999, Cukierman 2002, Cukierman and Gerlach 2003, Cukierman and Muscatelli 2008). They model this asymmetry in terms of half-quadratic output gap preferences in the central bank loss function or a reaction to shortfalls only in the central bank reaction function. Cukierman and Gerlach (2003) write that "Even if policy makers are content with the normal level of employment there is an *inflation bias* if the central bank is uncertain about the future state of the economy and is more sensitive to policy misses leading to employment below the normal level than to policy misses leading to employment above it." Cukierman and Gerlach (2003) also found empirical evidence supporting half-quadratic preferences for output for OECD countries including the United States. In a way, the Fed's new strategy serves to corroborate the claim by Cukierman and Gerlach, while potentially contributing to an inflation bias and a policy that waits too long.

CREDIBILITY AND MARKET-BASED MEASURES OF LONG-RUN INFLATION EXPECTATIONS

With regard to central bank credibility, Reis focuses mostly on measures derived from bonds and derivatives traded on financial markets, in particular, inflation swaps or nominal and inflation-indexed bonds over 5- and 10-year horizons. For the United States, this measure of expected inflation from five-to-ten years into the future had risen by about 1.3 percentage points from 2020 to 2022. With co-authors, Reis has developed methods for using option prices to estimate the distribution of such long-range market-based inflation forecasts (see Hilscher, Raviv, and Reis 2022). The results are striking. Just as in the case of household expectations, the distributions he derives shifted rightward throughout 2021. Tail probabilities for long-run inflation exceeding 4% or 5% in the long run moved up in the second half of 2021 for the United States, and at the start of 2021 for the euro area. Clearly the measures Reis calculates were signaling the need for convincing policy action. Nevertheless, central banks continued to rely on the credibility of their policy targets to keep inflation expectations anchored.

Turning to the euro area, the 5-year, 5-year forward expectation from inflation swaps increased from a low point of around 1% in the second quarter of 2020 throughout the year 2021 to about 2% by the end of that year. In 2022, it increased further towards 2.5%. It is surprising that this steady increase did not feature importantly in ECB communication.

By contrast, in 2014, a decline in these measures triggered aggressive policy easing. At the Jackson Hole conference in August 2014, ECB president Mario Draghi famously stated: "Over the month of August, financial markets have indicated that inflation expectations exhibited significant declines at all horizons. The 5-year, 5-year swap rate declined by 15 basis points to just below 2%—this is the metric that we usually use for defining medium-term inflation. But if we

go to shorter- and medium-term horizons, the revisions have been even more significant. . . . The Governing Council will acknowledge these developments and within its mandate will use all the available instruments needed to ensure price stability over the medium term."

Throughout the year 2021, the 5-year, 5-year measure increased much more. While it approached the ECB's target from below, it was a clear signal that markets were anticipating a substantial increase in long-run trend inflation. This would have supported the case for an earlier start of gradual policy normalization. Instead, the ECB waited, thus responding asymmetrically to the increase in market-based long-run inflation relative to the earlier decrease in this measure.

One caveat is in order, however. The long-run market-based inflation forecasts are very sensitive to short-run developments. In particular, the 5-year, 5-year forward expectation for inflation has moved quite often in lockstep with energy prices, with the 5-year, 5-year measure coming down and then rising sharply with energy prices. This is quite apparent from figure 9.7. Energy prices, however, exhibit substantial short-run volatility. By contrast, survey expectations from professional forecasters have not moved very much in either direction.

Thus, the long-run market-based forecast of inflation probably does not offer that much more new information relative to short- to medium-term forecasts, and possibly the same applies to long-dated inflation options. Even so, the distributions Reis estimates provide very useful and important information for central banks to consider and may just be telling us more about a much closer horizon.

FOCUS ON THE EFFECTIVE LOWER BOUND AND A LOWER EQUILIBRIUM REAL INTEREST RATE

Since the financial crisis, central banks have been concerned with the effective lower bound on nominal interest rates, which forces

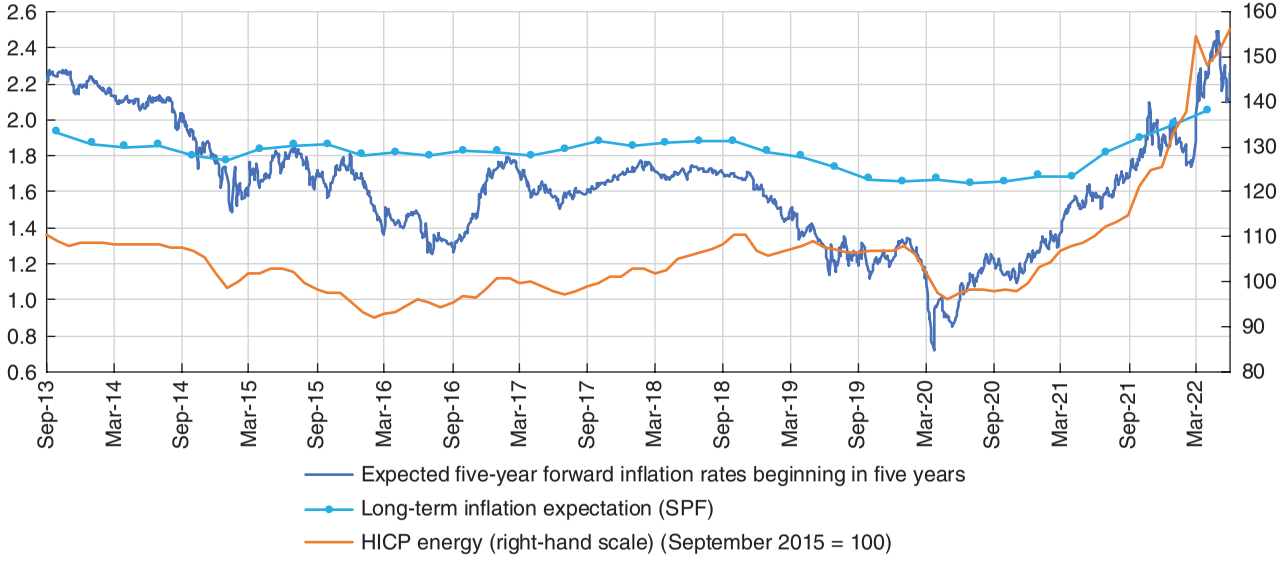

FIGURE 9.7. Long-Term Inflation Forecasts and Energy Prices in the Euro Area

Sources: European Central Bank, Thomson Reuters Datastream.

Notes: (1) Market-based long-term inflation expectations looking ahead five years, for five years. Derived from the fixed payments of inflation swaps that are exchanged for the annual inflation rates realized over the next five or ten years; (2) Survey of Professional Forecasters expectation for inflation looking ahead five years.

them to switch from the central bank rate to quantitative easing as primary policy instrument. Additionally, a perceived decline of the equilibrium real interest rate (r*) means that they worry about a greater likelihood of policy being constrained in this manner in the future. Approaches to dealing with this combined policy challenge constituted the main focus of the Fed's and the ECB'S recent strategy reviews, which were completed respectively, in 2020 and 2021.

Reis questions the empirical evidence for the decline of real equilibrium returns. He argues that it is derived primarily from the decline of government bond rates. Instead, he provides some empirical measures of the returns on private capital, which apparently have not declined. He speculates, for example, that this may be a sign of a misallocation of capital away from private investment in the capital stock and towards financial investments. Rather than increasing public debt to raise bond rates, he argues for lowering the gap between the returns on private capital and the returns on public debt by supply-side policies.

Reis's provocative challenge of entrenched central banker thinking is worth serious consideration. I would certainly support the call for renewed effort on supply-side policies. Yet, a caveat is in order. Much of central bank research on low equilibrium real rates does not rely on bond rates. It treats r* as an unobservable variable to be estimated from a simple aggregate demand and Phillips curve setup. The only rate used in estimation is the short rate. R* estimates from this framework declined from 2009 onwards partly because of lower potential growth estimates and partly because low interest rates did not stimulate inflation as expected (see Wieland 2018). These estimates are quite sensitive and may well rise again along with higher inflation and higher policy rates (see Beyer and Wieland 2019).

Yet in my view, the Fed and the ECB delayed too long even if one accounts for the proximity to the effective lower bound. Early research on monetary policy at low inflation showed that it is optimal to lower interest rates earlier and keep them near zero

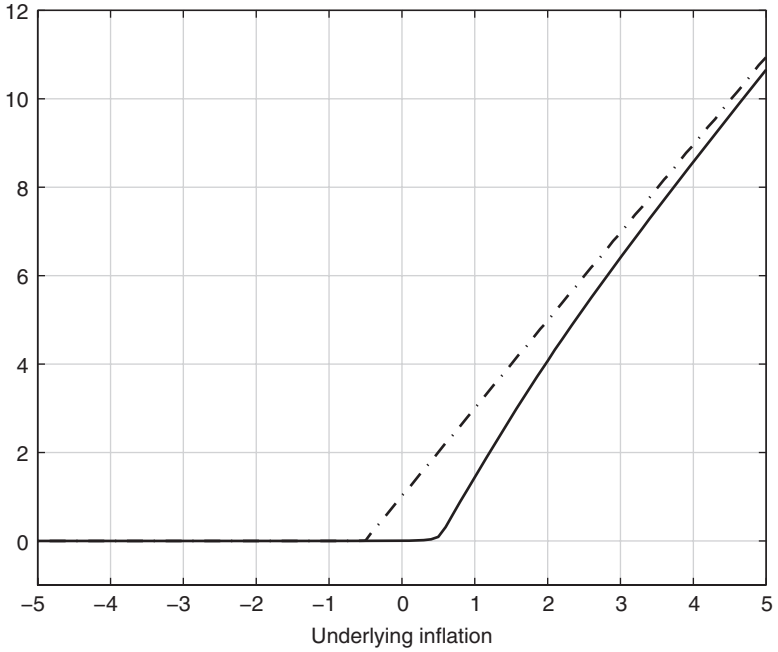

FIGURE 9.8. Optimal Interest Rate Setting with Zero Lower Bound and Uncertainty about QE Effectiveness

Source: Orphanides and Wieland 2000.

Notes: The solid line shows the optimal policy for the federal funds rate with the zero bound and uncertainty regarding QE effectiveness. The dash-dot line illustrates the optimal policy in the absence of uncertainty.

longer than in a standard linear inflation targeting framework. Orphanides and Wieland (2000) derived this policy implication in an inflation-targeting framework with a zero lower bound on nominal policy rates and multiplicative uncertainty about the effectiveness of quantitative easing.

As inflation declines, it is optimal to use the interest rate instrument more aggressively before switching to quantitative easing where the impact is uncertain. Similarly, as inflation rises, the optimal interest rate policy stays at the zero bound for longer than the benchmark linear policy. This is directly apparent from figure 9.8,

which replicates the optimal interest rate reaction function from Orphanides and Wieland (2000).

This analysis illustrates that "lower for longer" refers to the comparison with a linear benchmark that either ignores the uncertainty about the effectiveness of quantitative easing or ignores the effective lower bound altogether. Yet, the responsiveness of the optimal interest rate setting to inflation is the same whether inflation declines towards zero or whether it rises from zero to positive territory. In both cases, it is characterized by a movement along the solid line, though in opposite directions. ECB policy seems to have proceeded quite differently. From 2014 onwards, the decline in inflation was quickly followed by aggressive and substantial policy easing. Yet, when inflation rose in 2021, the central bank balance sheet continued to increase, and policy tightening was delayed.

References

Beyer, Robert C. M., and Volker Wieland. 2019. "Instability, Imprecision and Inconsistent Use of Equilibrium Real Interest Rate Estimates." *Journal of International Money and Finance* 94 (June): 1–14.

Brainard, William. 1967. "Uncertainty and the Effectiveness of Policy." *American Economic Review* 57 (May): 411–25.

Christodoulakis, George, and David Peel. 2009. "The Central Bank Inflation Bias in the Presence of Asymmetric Preferences and Non-Normal Shocks." *Economics Bulletin* 29, no. 3:1608–20.

Clarida, Richard, Jordi Galí, and Mark Gertler. 1999. "The Science of Monetary Policy: A New Keynesian Perspective." *Journal of Economic Literature* 37, no. 4 (December): 1661–1707.

Cukierman, Alex. 2002. "Are Contemporary Central Banks Transparent about Economic Models and Objectives and What Difference Does It Make?" Federal Reserve Bank of St. Louis, 15–35.

Cukierman, Alex, and Stefan Gerlach. 2003. "The Inflation Bias Revisited: Theory and Some International Evidence." *Manchester School* 71, no. 5: 541–65.

Cukierman, Alex, and Anton Muscatelli. 2008. "Nonlinear Taylor Rules and Asymmetric Preferences in Central Banking: Evidence from the United

Kingdom and the United States." *B. E. Journal of Macroeconomics* 8, no. 1 (February): 1–31.

Dräger, Lena, Michael J. Lamla, and Damjan Pfajfar. 2022. "How to Limit the Spillover from the 2021 Inflation Surge to Inflation Expectations?" Working Paper Series in Economics 407, University of Lüneburg, Institute of Economics.

Hilscher, Jens, Alon Raviv, and Ricardo Reis. 2022. "How Likely Is an Inflation Disaster?" *Review of Financial Studies* 35, no. 3: 1553–95.

Orphanides, Athanasios, and Volker Wieland. 2000. "Efficient Monetary Policy Design near Price Stability." *Journal of the Japanese and International Economies* 14, no. 4: 327–65.

Reis, Ricardo. 2020. "The People vs. the Markets: A Parsimonious Model of Inflation Expectations." CEPR Discussion Paper 15624.

———. 2021. "Losing the Inflation Anchor." Brookings Papers on Economic Activity, September 9.

Söderström, Ulf. 2002. "Monetary Policy with Uncertain Parameters." *Scandinavian Journal of Economics* 104, no. 1: 125–45.

Svensson, Lars E. O. 1997. "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets." *European Economic Review* 41: 1111–46.

Swanson, Eric T. 2000. "On Signal Extraction and Non-Certainty-Equivalence in Optimal Monetary Policy Rules." *Finance and Economics Discussion Series* 2000-32, Board of Governors of the Federal Reserve System.

Tambakis, Demosthenes. 1999. "Monetary Policy with a Nonlinear Phillips Curve and Asymmetric Loss." *Studies in Nonlinear Dynamics and Econometrics* 3, no. 4: 223–37.

Taylor, John B. 1993. "Discretion versus Policy Rules in Practice." Carnegie-Rochester Conference Series on Public Policy 39: 195–214. Amsterdam: North-Holland.

Wieland, Volker. 2006. "Monetary Policy and Uncertainty about the Natural Unemployment Rate: Brainard-Style Conservatism versus Experimental Activism." *B. E. Journal of Macroeconomics* 6: 1–34.

———. 2018. "The Natural Rate and Its Role in Monetary Policy." In *The Structural Foundations of Monetary Policy*, edited by Michael D. Bordo, John C. Cochrane, and Amit Seru. Stanford, CA: Hoover Institution Press.

Wieland, Volker, Elena Afanasyeva, Jinhyuk Yoo, and Meguy Kuete. 2016. "New Methods for Macro-Financial Model Comparison and Policy Analysis." In *Handbook of Macroeconomics*, edited by John B. Taylor and Harald Uhlig. Vol 2. Amsterdam: North-Holland.

GENERAL DISCUSSION

ARVIND KRISHNAMURTHY (INTRODUCTION): We are experiencing a period of a rapid increase in measured inflation as well as an increase in the mean expectation for inflation rates over the next few years. Beyond these mean shifts, there has also been an increase in uncertainty over inflation outcomes, as Ricardo Reis's paper in this volume makes clear. It is worth highlighting this increased uncertainty, which reflects (1) model uncertainty and (2) uncertainty over economic outcomes.

The 2010s were a period of monetary experimentation, with massive increases in monetary aggregates, and forward guidance policies aimed to keep long-term interest rates low. Yet, inflation rates generally undershot the Fed's 2% target, albeit by small margins, and inflation expectations as measured from asset markets remained remarkably stable around 2%. The US experience of low inflation and low inflation expectations during a period of substantial monetary stimulus is echoed in the experience of Europe in the 2010s, as well as that of Japan going back another decade. These episodes call into question models of the inflation-generating process running through money mechanisms.

There has also been a reexamination of models of the inflation mechanism running from labor market tightness to increases in wages and prices, i.e., the Phillips curve. The relative insensitivity of inflation to changes in unemployment in the last two decades has led many economists to estimate that the Phillips curve has flattened substantially. What is the current slope of the Phillips curve, and how important is this relationship to models of the inflation process?

The model uncertainty faced by researchers has a counterpart in the deliberations of policy makers. The Fed, prior to the COVID recession, embarked on a reassessment of its monetary policy framework. This culminated in Jay Powell's August 2020

speech laying out the new monetary framework of flexible average inflation targeting.

I make these points primarily to highlight that in 2020, before the COVID recession, policy makers, researchers, and investors faced considerable uncertainty regarding their models of the inflation-generating process as well as uncertainty over the parameters of a new Fed Taylor rule.

Model uncertainty has been coupled with a series of unusual shocks that has increased economic uncertainty. How would an economy undergoing the shutdown of COVID react? How much of the heightened unemployment of the COVID recession was a response to reduced demand in the recession and how much a response to workers' shift in individual labor supply, driven by pandemic concerns? As the supply bottlenecks of COVID eased, would inflation rates normalize? And as the pandemic-driven economic effects in the US have diminished, the world has been faced with another shock, the war in Ukraine. Navigating monetary policy through these uncertain times is challenging, as we have heard from policy makers in this conference. For agents in the economy that set prices, inflation rates, and asset values, forecasting economic outcomes and policy reactions is doubly challenging.

To return to the point where I started: the challenge of inflation in the current environment is one not only of high mean inflation but also of significant uncertainty and inflation risk.

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RICARDO REIS: I want to take a minute to emphasize a point that Volcker made: measures of expectations are noisy. Take measures of disagreement, like skewness, a third moment sometimes estimated on samples with 500 respondents. Month to month, it is going to move quite a bit simply due to noise, which should best be ignored.

Next, say you were brought up at the inflation desk of the Fed between 2000 and 2019. Because you have been living in a regime in which inflation is very strongly anchored at 2%, all you're getting from expectations jumping up and down is the noise. You would convince yourself that expectations are garbage in terms of forecasting inflation rate. However, when you have a regime change, like potentially in 2021, the expectations data is now moving a lot. Now, the expectations data is quite revealing, including its second and third moments. That happened during the [Chairman Paul] Volcker period. And that's what has been happening in the last year or so.

Similarly, with options, I am looking at tails. If I'd shown for instance the probability of deflation, where they're a little higher, month to month they can jump quite a bit and I would make nothing of it because it just jigs back and down. But when you see a probability like that tail of high inflation that used to jump up and down between 1% and 5% in seemingly random ways, and all of a sudden it moves to 16% to 20% for many months, then I'm paying attention. So this is just to say that you don't want to rely on these data for month-to-month forecasting. But it's only when you see these big movements that I think it's worth paying attention.

ROBERT HALL: It seems to me there's lots of evidence that the Phillips curve just recently has become a lot steeper. And the steepness of the Phillips curve in a New Keynesian setting in a model such as Ricardo's famous job market paper, the higher the dispersion of the environment of the firm, the more frequently it will adjust its price. There hasn't been much discussion at this conference about this point. But I take it from Ricardo's nodding vigorously he agrees that the figuring out what's going on today is going to involve a considerable increase in the steepness of a New Keynesian Phillips curve, maybe almost vertical given the speed with which wage and price inflation have changed recently.

REIS: I agree with that, but you've been much too generous toward me, Bob. I think it was Lucas, who argued forcefully that in a world that's very volatile, the Phillips curve becomes steeper. Absolutely, models of endogenous attention and price stickiness will have this property, and that may be consistent with the facts right now.

JAMES BULLARD: Jim Bullard, St. Louis Fed. So, I have a question for Ricardo. First of all, I love the options of pricing stuff. That was really good. But on the picture that has the returns to capital and then the returns to short-term Treasuries in real terms since the 1980s, we stared at that picture in St. Louis, but maybe we came to different conclusions than you did. There's a lot of issues here about the equity premium. There's a New Keynesian model that has capital in it. Don't you have to modify that model and then tell me where the r-star is in the Taylor rule, instead of just putting the m-star in the Taylor rule? So I think that that would be an issue. And then, you know, I guess the main reading of that diagram was, and I think is, that there's a demand for highly safe securities in the last two decades, or three decades. And this is what's going on. There's a demand for global liquidity, and there's not enough issuance around the world. There's a shortage of safe debt.

ARVIND KRISHNAMURTHY: Can I add one thing to that? The Fed sets the rate on the safe and liquid asset as opposed to the rate on m-star. So wouldn't that be the relevant thing to measure in a model?

REIS: Some telegraphic answers. First, the equity premium. If I had been measuring returns on the stock market, then I would worry a lot about that. Instead, I use national income and product accounts, so we're not talking necessarily about premiums on financial assets. Second, there could have been a change in aggregate risk since there's certainly a gap between *m,* a risky rate, and *r*, a safe rate. Seeing an enormous increase in the *m* minus *r* gap, either you think that there's been a dramatic increase in risk aversion or an increase in demand for safety. That seems implausible. Instead, maybe there's something that made either

Treasuries more attractive or the capital stock less attractive. If so, the efficiency of allocation between the capital stock and the public debt may have changed. That then implies that the dangers of the ZLB, whether there is a deflation trap or not, depends on how the *m* minus *r* gap behaves, not solely on how *r* behaves. That is my point. We are then discussing the diagnosis of that change, and it's not enough to dismiss it as saying, "Oh, it was just risk or an equity premium that has changed." You have to go on what generated it. And thirdly, related on the model, yes, I did not show the equations, but that's what I've been doing. I start with a New Keynesian model with capital and nominal rigidities, and the *m* minus *r* changing because of misallocation, and I end up with the three conclusions I told you: (1) the ZLB is not as bad, because the *m* margin is adjusting; (2) raising future inflation expectations does not have quite as much as a kick on real activity, and (3) aggregate demand multipliers are not so large. And then on Arvind . . .

KRISHNAMURTHY: I was pointing out that the Fed should care about r-star more than m-star because the zero lower bound on their policy rate concerns r-star.

REIS: I completely agree. There is an important distinction. For what the central bank sets, r-star is the key constraint on policy thing since your actions are on the yield curve. But, the question I raised is what are the effects of that constraint and of policy on overall economic outcomes? That determined how actively should you fight that constraint on the *r* and on the r-star. Whether *m* fell in tandem with the *r* or not, or if there's a gap, changes that answer. So thanks, for the question.

PATRICK KEHOE: Patrick Kehoe of Stanford. Ricardo, when you were talking about there being an increase in the variance of beliefs that predated the shift in the mean of beliefs, do you interpret that initial increase in variance as an indication that people's expectations became unanchored? And that's all you're picking

up in the first bit, and that means people are ready to move their beliefs, and then they actually started moving later. And Volker responded, Do we have nonlinear maps between heterogeneous beliefs and outcomes in one nonlinear quadratic model? Is that how we're using the idea that before things move, people are getting less sure of themselves, and that what was the spreading out of the variances namely, more weight in the tails? And that shows me that it's going to move? Volker instead was talking about nonlinearities, but I don't think you actually said much about nonlinear maps between distribution to beliefs and outcomes.

REIS: There are two separate points, and I made one, and Volker made a different one. And so let me distinguish them to be clear. In the data, when you have these large changes in regime, it is as if some people figure it out right away and they move to the new regime. That's where you see the spread and the variance. That's where you see the skewness, and then the other ones catch up. When I was documenting these facts 20 years ago, I did so because in these models of sticky information, some guys figured it out faster and the other ones catch up. This is about how during shifts in the regimes you observe these dynamics in the population.

A separate point, which Volker made, is to what extent people are inattentive? And that is like the inaction models of inattention in my doctoral thesis. There's a fixed cost to paying attention, and the central bank has a "capital of inattention" when agents are in the inaction range. Then something big happens, they shift to attention, and policies have to address it. That's a totally separate thing.

MARC KATZ: Marc Katz, Broadfield Capital Management. You have in your slides sort of a propagation of an expected inflation curve. And if you look at a curve like that, it could really give you sort of a false sense of security about what future inflation may be for the same reasons that Treasury yields are unexpectedly low, for reasons that Jim talked about. But have you considered propa-

gating a curve of expected *m*, i.e., expected nominal return on capital, to gauge the market's true concern about inflation? That versus just looking at inflation expectations by only propagating a risk-free curve?

REIS: That's a good question. I have no idea how to do it for *m*. For *r*, I was showing you 10-year rates, and people will make a distinction between the 10-year, the short term, and others. For the *m*, this is a return to capital. I don't know how to map this to a 1-year or 5-year horizon, let alone build a curve on it.

KATZ: Intuitively, it seems like expected returns on capital have increased dramatically recently, perhaps partially due to increases in expected inflation and required higher real returns.

REIS: When you mention expected returns on capital, you are referring to expected returns on equity, right? But there's many claims on the capital stock of the economy. And to what extent those converge or not to the ultimate returns on capital is something that I'm not super comfortable making assumptions on. But if you're willing to make some assumptions, yes, you could do that, as you say, from the prices of equities and others. I mean, what I do know from the work of my distinguished chair is that if you really try to strip out from the private sector everything that makes it the private sector—aggregate risk, everything—to try to come up as close as possible to Treasury, you still have an *m* minus *r* gap. There's something special about Treasuries, say convenience or safety.

ELENA PASTORINO: Elena Pastorino, Hoover Institution. And this is a question for Ricardo. You talked about the issue of credibility and the anchoring of inflation expectations. But after all, we live in a different monetary policy world after the very public "soul searching" that took place in 2019, at least on this side of the ocean, with the strategy review of the Fed. So in this new world, how should we be thinking about establishing credibility, especially in light of asymmetric inflation rules? In your opinion,

what concrete steps should monetary authorities be undertaking in this dimension? Thank you.

REIS: That's a great question. Insofar as I showed you some estimates of those tail probabilities, you see them increasing after 2021. There are three hypotheses that I cannot distinguish. One, they rose because of the 2019–20 mission review, but it took a while for you to be able to see this in the data. Two, it was the policy choices (and maybe mistakes) that happened in 2021, which have been discussed here this morning. Three, that it was neither of these two, but long-term trends common across central banks, in terms of the monetary environment and others, including shifts in r and m. I don't know. We can discuss whether we like the new framework of the Fed or not. But the fact that we had such a huge pandemic shock right after it was adopted means that it's hard to test it. Maybe it was the best framework ever, it just got really unlucky? Or maybe it was a terrible framework and would have done worse anyway? So I guess I'm not answering your question, but I'm hopefully making the question more interesting, and then maybe someone will be able to answer it by solving the identification problem.

One thing that is interesting is that at the other side of the Atlantic, the big concern was this probability of deflation, and it was quite high, around 20%. It's quite interesting that when the ECB changes its strategy, that deflation probability falls, and then it kind of comes back up. So I'll just leave it at that.