Inflation Past, Present and Future: Fiscal Shocks and Fiscal Limits

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Abstract

Our current inflation stemmed from a fiscal shock. The Fed is slow to react. Why? Will the Fed's slow reaction spur more inflation? I write a simple model that encompasses the Fed's mild projections and its slow reaction, or traditional views that inflation will surge without swift rate rises. The key question is whether expectations are forward looking or backward looking. Price stickiness means that even with forward-looking expectations, inflation will persist past an initial shock. To alleviate inflation or reduce inflation, fiscal and monetary policy must be coordinated. A form of unpleasant arithmetic holds in modern interest-rate based and cashless models. The Fed can reduce inflation now, but only by increasing inflation later. Fiscal policy to pay higher costs on the debt and a windfall to bondholders must accompany an interest rate rise, or that rise will not lower inflation. On the other hand, coordinated fiscal, monetary and microeconomic reforms can, and have, swiftly eliminated inflation without the major recession of the early 1980s.

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1 Introduction

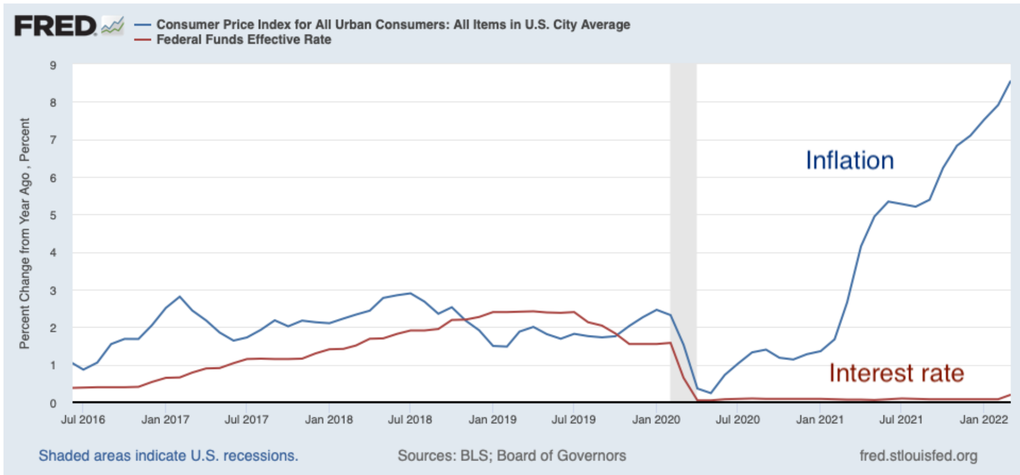

Figure 1: Inflation and Federal Funds Rate

As Figure 1 reminds us, we are in the midst of an inflation surge that started in January 2021. What caused it? Will it continue, get worse, or subside? How will inflation end? What policies will work, and what will not?

I start by documenting the fundamental fiscal source of our current inflation. We had a $5 trillion fiscal helicopter drop. Inflation is not a surprise.

The Fed is, by historical standards, reacting very slowly to this inflation. Does the Fed's slow reaction amount to additional stimulus, that will unneccessarily boost inflation beyond this initial impulse? Why do the Fed's projections indicate that inflation will fade away without sharp interest rate rises? I write a simple model that unites two views of this question. If expectations, especially in the Phillips curve, are adaptive, reacting to past inflation, then I replicate the traditional view that the Fed is horribly behind the curve and inflation will explode unless it raises interest rates swiftly. However, if expectations are forward-looking, if the Phillips curve is centered on expected future inflation, then I can replicate the Fed's projections. The Fed's view is not, thus, inconsistent or incoherent. It comes from a standard, well-developed view of the world, embodied in new-Keynesian models for the last three decades. That observation at least allows us a model-based debate whether the Fed is right in its projections.

I ask, how long will inflation persist? One might think that once the fiscal or monetary stimulus is over, inflation will end. I show that with sticky prices, inflation has considerable persistence. This persistence holds even with totally forward-looking sticky prices – it does not require indexation, slow pass through or other sources of momentum. Thus, even with no additional fiscal or monetary stimulus, we should expect inflation to be relatively persistent.

I then consider how Fed reaction might tame inflation. Given that inflation was sparked by fiscal policy, given the large amount of debt outstanding, and given persistent primary deficits, fiscal constraints on monetary policy and monetary-fiscal coordination will be crucial in both questions. I document a form of "unpleasant arithmetic" in interest-rate based economic models. With no change in fiscal policy, by raising interest rates the Fed can lower inflation now, but only by raising inflation later.

I then ask, what will it take to disinflate? Suppose we get to 1979, can we repeat 1980, or are there better options? Again, fiscal constraints will make a disinflation harder this time. In 1980, the debt to GDP ratio was 25% and the entitlement crisis was decades away. Now the debt to GDP ratio is 100%, the underlying inflation is more clearly fiscal, and we face large structural deficits and looming entitlements. Raising interest rates will increase debt service costs, and lower inflation will require a bondholder windfall. Without a coordinated and durable monetary, fiscal and microeconomic reform, a purely monetary stabilization will fail. On the other hand, the lessons of the ends of hyperinflation, the lessons of the inflation target episodes, and the insights of economics since the 1980s suggest that such a stabilization can be much less painful than 1980.

2 Where did inflation come from?

In my view, the underlying source of the current inflation is fairly straightforward: Our government printed up about $3 trillion in extra money, and sent it out as checks. It borrowed another $2 trillion and sent more checks. (Numbers from Cochrane (2022b), Chapter 21, and Cochrane (2022a), which explore the argument in more depth.) It was a classic helicopter drop.

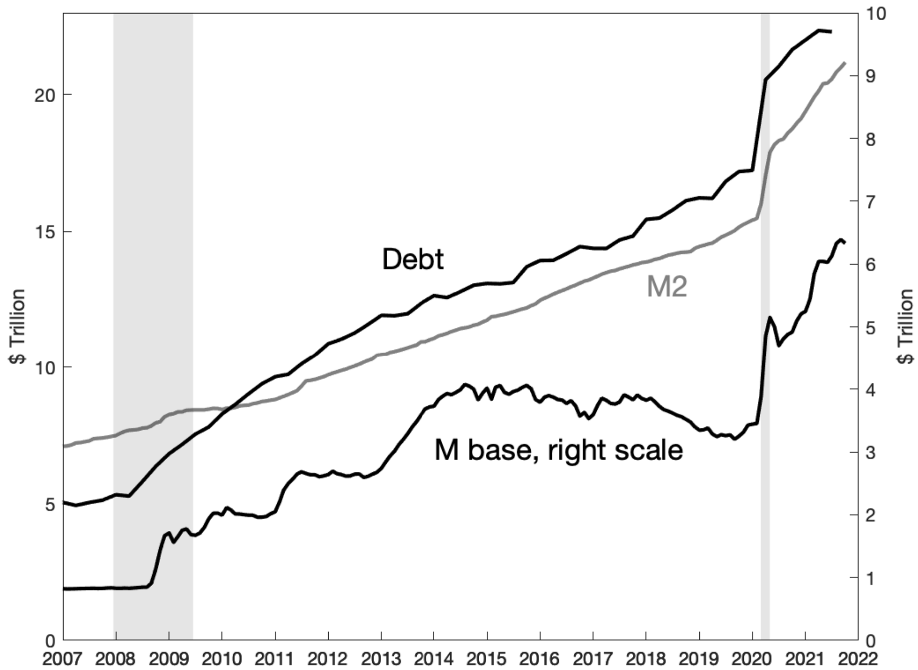

Figure 2: Money and Debt in the Covid Recession and Aftermath. Reproduced from Cochrane (2022b).

It was a *fiscal* helicopter drop. Imagine that the Fed had increased the monetary base by $3 trillion, as it did, by buying existing debt, and there was no deficit. Surely that would not have had the same effect. Inflation comes from the vast expansion in the overall amount of government debt, not just from a mistaken composition of that debt, too much overnight debt (reserves) and not enough longer term debt (Treasury debt). Imagine that the Treasury had sent people shares in a mutual fund backed by Treasury debt, with thereby no direct increase in reserves or M2. Surely that would have had much the same effect.

In broad outline, this is not that controversial a view. For example, Summers (2021) wrote presciently the same view (So did Cochrane and Hassett (2021), but our view is less surprising and much less influential). Summers has a different analytical framework in mind, involving flow budget deficits and fiscal stimulus rather than the stock of debt and expectations of repayment, but for now that difference does not matter in isolating the shock.

The reigning alternative theory is that inflation came from a "supply shock." Much of this discussion confuses individual supply curves and relative prices with aggregate supply curves and overall inflation. A supply shock can raise the price of affected goods relative to others, and relative to wages. It does not raise all prices and wages together. (At least not directly. One has to work the supply shock into a Phillips curve. It has to become part of the wage and price stickiness part of a model. My point is just that the obvious story—it's hard to import chips so the price of chips goes up, causing inflation—is wrong.)

There is nothing unusual about the interest-rate part of monetary policy until inflation broke out in January 2021. It's hard to make a case that interest rate policy *sparked* this inflation. "Monetary policy" is responsible to the extent that the Fed participated in the creation and helicopter-drop of $3 trillion of reserves, but not in an interest-rate shock. One may also fault monetary policy somewhat for not "normalizing" interest rates more quickly once it became clear that the recession was a supply-side V shaped affair, not a prolonged demand-side affair; for not following a Taylor Rule that reacts to employment. But the Fed clearly abandoned that rule after the 2016 tightening and in its consequent new strategy. The issue is not root cause, but lack of response. The issue is largely whether the Fed should have, and should still *react* more and more promptly to the emergence of inflation, whose root cause lies elsewhere.

3 Is the Fed behind the curve?

By historical standards, the Fed is moving quite slowly. Inflation has been with us for over a year. The CPI is 8% and core CPI 6.5% (March 2022), yet the Fed only in March budged the interest rate up to 0.33%, with a hint of half a percent more in the summer. If inflation continues at this rate, and the Fed response continues at this rate, it will be years before interest rates finally catch up to inflation.

The Fed is slow by comparison to the last tightening round, in 2017, shown in Figure 1. The Fed is even slow by contrast with the 1970s, as shown in Figure 3. In each of the three surges of inflation, the Fed raised interest rates one for one or more with inflation. The 1970s Fed is criticized because it *only* raised rates one for one. Only in the early 1980s did the Fed finally substantially and persistently raise real interest rates, and in doing so cause a harsh recession. Even in the 1970s, the Fed never waited a whole year, or let inflation get 8% above the Federal funds rate.

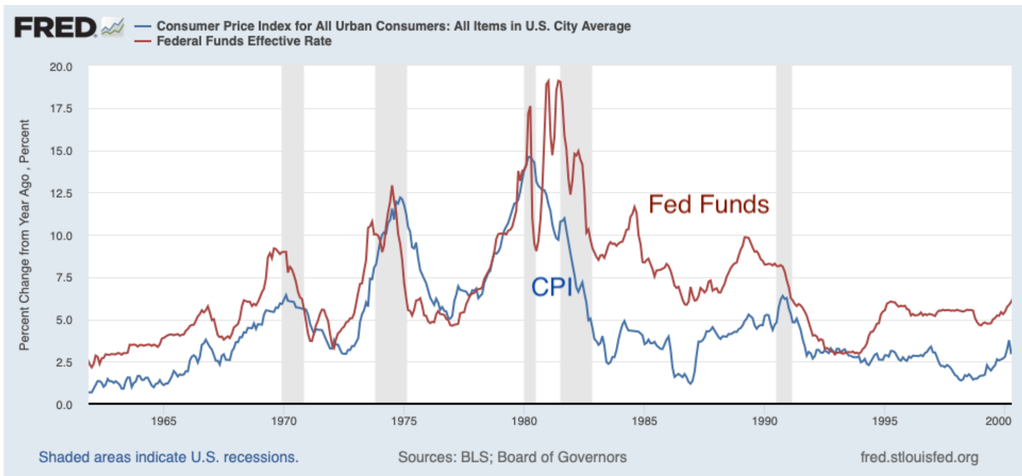

Figure 3: Inflation and Federal Funds Rate in the 1970s

Does it matter? Even if the original inflation is not the Fed's fault, resulting from a fiscal shock or supply shocks, will the Fed's slow response, and a consequent period of negative real interest rates induced by high inflation, act as additional monetary stimulus driving up inflation even further?

When we look for reasons for the Fed's slow action, must we jump immediately to political answers, a desire to sustain its reputation after having made forward guidance promises to keep rates low, or to a simple policy mistake? Yes, if the slow response spurs more inflation, but perhaps not if there is a sensible view of the world in which the Fed's slow reaction does *not* spur inflation ever higher.

What does the Fed think will happen? Figure 4 presents the Fed's projections from the March 15 2022 outlook[1].

This projected scenario is dramatically different from a repetition of the 1970s

[1] https://www.federalreserve.gov/monetarypolicy/fomcprojtable20220316.htm

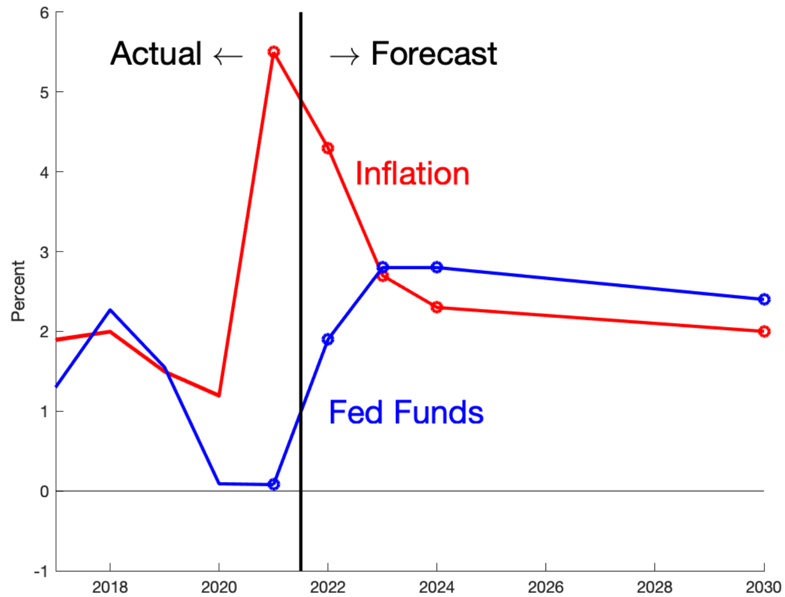

Figure 4: Federal Reserve Projections. I plot the Feds "long run" projection at 2030.

with surging inflation, or of 1980 in which inflation went away after a sharp rise in interest rates. *The Fed believes inflation will almost entirely disappear all on its own, without the need for any period of high real interest rates to bring inflation down.*

What view of the world underlies the Fed's projections? Inflation continues through 2022 and a bit into 2023. Thus, we cannot understand the Fed's projections as simply a one-time price-level shock, a view that expected future inflation has not moved, so it can leave the nominal interest rate alone and the true real rate of interest measured by expected future inflation will not be that low. We cannot say that the Fed is following a Taylor rule that responds to expected future rather than past inflation, $i_t = \phi E_t \pi_{t+1}$, and the Fed just happens not to forecast future inflation. (As natural as such a rule may sound, it has some unpleasant dynamic properties. The conventional Taylor rule responds to current inflation for a reason.)

Figure 5 presents the 5 year Treasury and 5 year breakeven rates. Before we make too much fun of the Fed's projections, note the market seems to believe much the

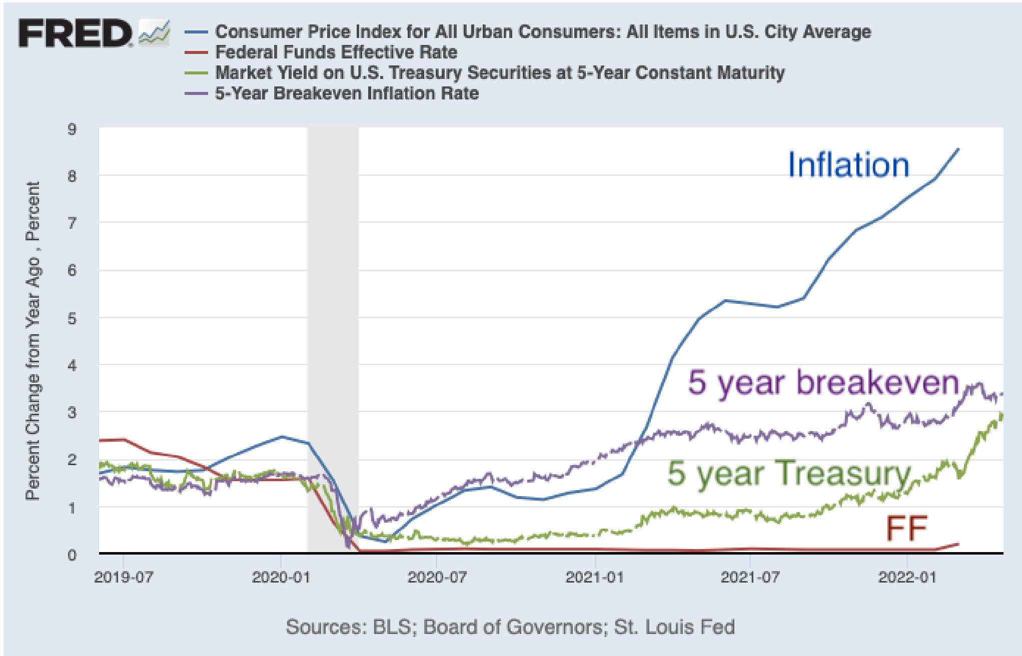

Figure 5: Market Forecasts.

same thing – this period of interest rates below inflation will not stoke further inflation. If anything, the recent rise in Treasury and breakeven rates seems most likely to be a reaction to the Fed's announcements that it actually is going to start raising interest rates, not connected to inflation.

Where does the Fed's projection come from? What logic does the Fed use? Might it be right?

To address this question, I wrote down a simple model, consisting of a static IS curve and a Phillips curve. (Cochrane (2022b) Section 17.1.)

$$x_t = -\sigma(i_t - r - \pi_t^e) \tag{1}$$

$$\pi_t = \pi_t^e + \kappa x_t \tag{2}$$

where $x =$ output gap, $\pi =$ inflation, $i =$ interest rate, and $r =$ steady state real rate. There are two variants: adaptive expectations $\pi_t^e = \pi_{t-1}$ and rational expectations $\pi_t^e = E_t\pi_{t+1}$. A model with a dynamic IS curve gives much the same result, but I can solve the simpler model with a line or two of algebra.

The model's equilibrium condition is

$$\pi_t = -\sigma\kappa(i_t - r) + (1 + \sigma\kappa)\,\pi_t^e. \tag{3}$$

With adaptive expectations the equilibrium condition is

$$\pi_t = (1 + \sigma\kappa)\pi_{t-1} - \sigma\kappa(i_t - r).$$

With rational expectations, the equilibrium condition is

$$E_t\pi_{t+1} = \frac{1}{1 + \sigma\kappa}\pi_t + \frac{\sigma\kappa}{1 + \sigma\kappa}(i_t - r).$$

I calculate unemployment via Okun's law as $u_t = 4 - 0.5x_t$.

Now, fire up each model, start with last year's 5.5% inflation, put in the Fed's projected interest rate path, and let's see what inflation comes out.

The top panel of Figure 6 plots the result for the adaptive expectations model.

I think this model captures well widespread current intuition. Wherever it came from, the inflation shock creates a period of negative real interest rates as long as the Fed does not move. A negative real interest rate boosts inflation further, and around we go. If the Fed follows its current trajectory, inflation spirals out of control. Eventually, of course, the Fed will give in, raise rates in a hurry, and cause a large recession, something like a repetition of 1980 or worse.

The bottom panel of Figure 6 makes the same calculation with rational expectations. The inflation that defines the real rate in the IS and Phillips curves is now the next period's expected inflation. Picking $\sigma = 1$, $\kappa = 0.5$, I match quite well the Fed's forecasts. The Fed, and markets, seem to believe the rational expectations, new-Keynesian version of the model.

The central intuition comes down to the Phillips curve. Hold fixed the unemployment rate and output gap, and recognize we are in a bit of a boom, with positive output gap x and below-natural unemployment. In the adaptive expectations model, $\pi_t = \pi_{t-1} + \kappa x_t$, output is high when inflation is high *relative to past inflation.* Output is high when inflation is *increasing.* In the rational expectations model, $\pi_t = E_t\pi_{t+1} + \kappa x_t$, output is high when inflation is high *relative to expected future*

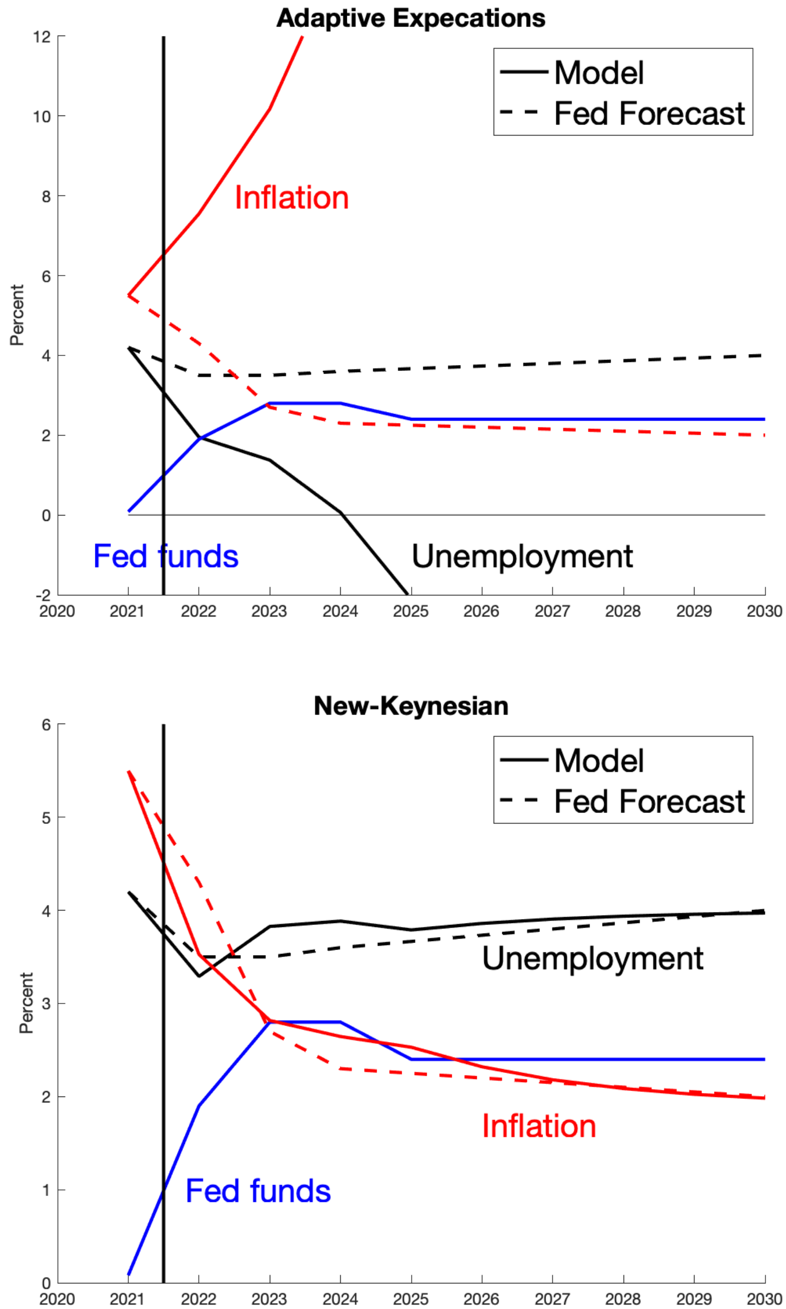

Figure 6: Fed Projections and Model Forecasts Given the Projected Funds Rate.

inflation. Output is high when inflation is high but *decreasing.* That's the Fed's view of the current situation.

By anchoring this impulse-response function on 2021 inflation, I avoid all the initial condition and equilibrium selection issues of new-Keynesian models, and the new-Keynesian vs. Fiscal Theory question. If we ask any model for the response to any shock, there is a big issue of how does inflation react at the moment of the shock. But we observe that response, 5.5%. So now we can compute the rest of the projection (impulse-response function) taking this initial inflation response from the data, and neatly avoid all those controversies.

The rational expectations logic works from future to past. If people expected really high inflation in the future, then inflation would be even higher today. The fact that inflation was *only* 5.5% in 2021 despite a rapid recovery tells us that people expected less inflation in 2022 and beyond.

Figure 7 presents the point in another way: To attain the Fed's projected path for inflation, starting with 5.5% 2021 inflation, what *should* the interest rate projection be? To make this calculation, I solve the equilibrium condition (3) for the interest rate

$$i_t = r + \frac{1+\sigma\kappa}{\sigma\kappa}\pi_t^e - \frac{1}{\sigma\kappa}\pi_t.$$

Then I use the Fed's inflation forecast for π_t and π_t^e, either one period ahead or one period behind.

The top panel of Figure 7 shows that in the traditional adaptive expectations version of the model, we need sharply higher, Taylor-rule style interest rates, now. Those higher nominal rates create higher real rates, which bring inflation down. They also cause a recession: Unemployment rises over the 4% natural rate. The recession is not so bad in my plot, because the simulation starts at last year's PCE inflation, 5.5%, not, say, March 2022 8.5% inflation, or not the 10% or 12% inflation that Figure 6 says will break out by 2023 if the Fed continues to move slowly. The recession is also mild because the model is incredibly simplified, and because I chose a quite low price-stickiness parameter (high κ) in order to fit the rather surprising speed of the Fed's projected return to normal in the rational expectations version of the model. Larger initial inflation, a larger price-stickiness parameter designed to fit the world with this model, and a more detailed model can easily deliver a much

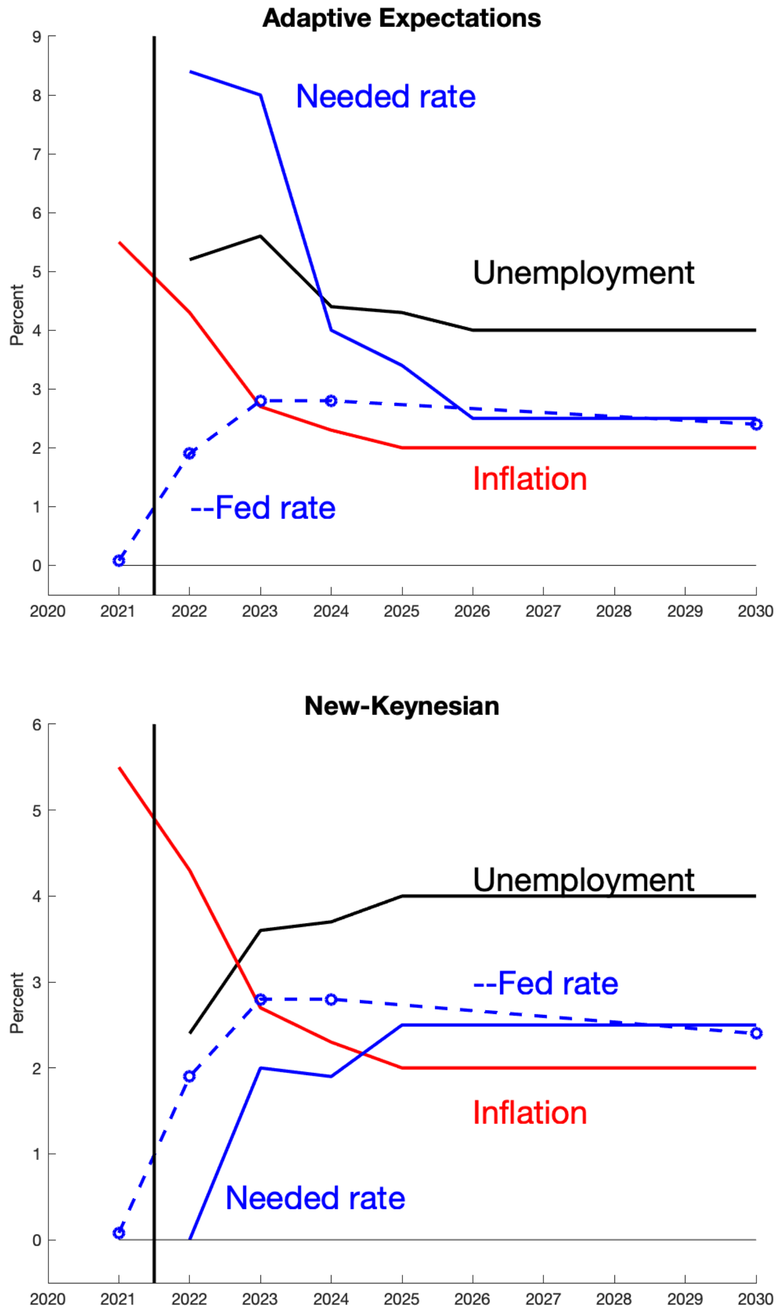

Figure 7: Interest Rate Path Needed to Attain the Fed's Inflation Target.

worse recession.

By contrast, the new-Keynesian model says that in order to hit the Fed's inflation forecast, interest rates can stay low, and indeed a bit lower than the Fed projects. And that path is perfectly consistent with unemployment slowly reverting to the natural rate.

3.1 Are the Fed's (implicit) beliefs nutty?

No. There is a more serious debate to be had here than is often acknowledged.

Surely, permanent, exploitable, immutable, mechanically adaptive expectations in the consumption, investment, and asset pricing relationships summarized by the IS curve, or in the pricing and wage-setting relationships summarized by the Phillips curve died in the mid 1970s. New Keynesian rational-expectations models are not that new, dating 30 years now from the early 1990s, and they are the standard workhorse of central banks and academic monetary policy analysis. It is at least not an outlandish or incoherent view.

On the other hand, it is hard to insist on perfectly forward-looking behavior, and especially rational expectations of the effects of novel shocks ($5 trillion of helicopter money, an immense pandemic and lockdowns, and so forth). Empirical Phillips curves contain at least some backward looking terms, which may also reflect wage indexation. Some new research tries to put less-than-rational expectations into new-Keynesian models, in order to rescue something like traditional beliefs, though at the cost of substantial mathematical complexity. (García-Schmidt and Woodford (2019), Gabaix (2020); on the latter see Cochrane (2016).)

One way to articulate the core question: Is the economy *stable* or *unstable* under an interest rate peg, or a target that moves less than one for one with inflation? If the answer to that question seems obvious, consider the experience of the zero bound era, plotted in Figure 8. The same logic that predicts an inflation spiral today, starting from a period of inflation, predicts a deflation spiral starting from a deflationary shock. More generally, the same logic predicts that if the interest rate does not move in response to inflation, then inflation must surely spiral in one direction or another. Many commenters loudly and correctly, with this model in mind, predicted such a spiral during the zero bound era. It never happened. Interest rates did not move, for

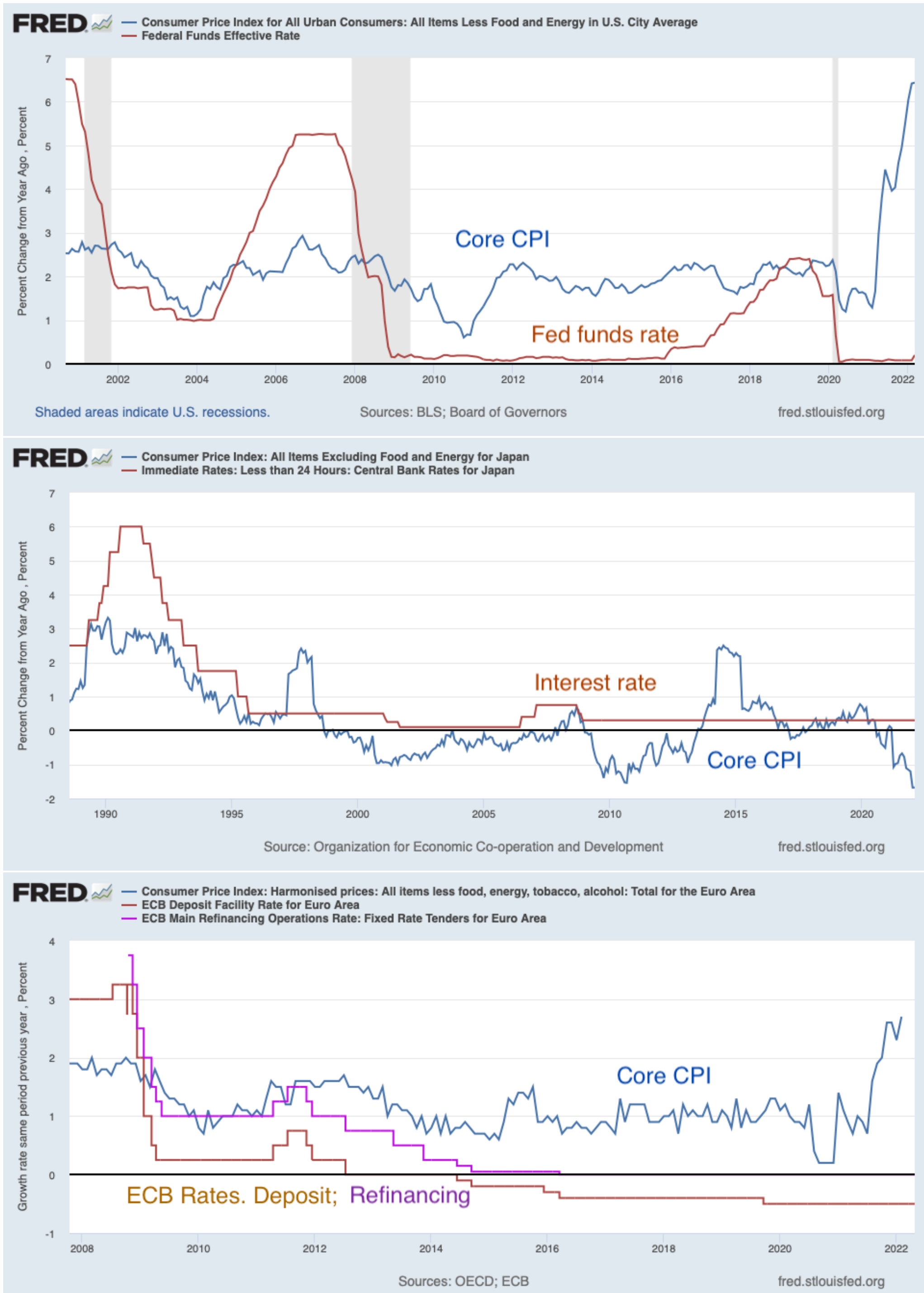

Figure 8: Core CPI and Fed Funds Rate in the Zero Bound Era. US, Japan, Europe

years on end, and could not move in the downward direction. Yet the deflation spiral never broke out. This model failed a test as clear as we get in macroeconomics. (See Cochrane (2018) for much on this point.)

Perhaps central banks have internalized the zero bound experience. If the widely forecast *deflation* spiral never broke out at the zero bound, why should they worry about the analogous *inflation* spiral now? The spiral prediction cried wolf.

In sum, the Fed's forecasts, are not necessarily nutty, rosy scenario, politically convenient denial, and so forth. Before criticizing based on the standard adaptive expectations model, let us at least acknowledge that there *is* a model that makes sense of the Fed's forecasts, it has dominated academic macroeconomics for 30 years, and it makes sense of the zero bound experience. Now we can debate if that model is right, or right in this instance.

My opinion—or at least a compromise view consistent with theory and evidence—is that the economy is stable in the long run, and the long-run predictions of the rational expectations model are right. Rational expectations are also right on average, which was always the central point: The Fed can fool people a few times, but once it gets in the habit of exploiting adaptive or other non-rational expectations as a matter of systematic policy, people catch on. Rational expectations are more likely in times of high and variable inflation when people pay more attention. Rational expectations are more likely as a description of policies that last a long time. For example a decade of high interest rates to fight inflation is more likely to feature rational expectations, for people to evaluate interest rates relative to future rather than past inflation, while a few initial months of a one-time shock may leave people puzzling what to expect. Expectations may not have moved fully this time, but don't expect that to be a robust, permanent, and reliable feature of the economy.

However, there is also a substantial temporary negative effect of interest rates on inflation, not captured by my little rational expectations model. Central banks can push down inflation by high interest rates, and do so. That short-run negative effect is more visible in historical episodes such as 1980 than the subtle long-run positive and stabilizing effect that we only see in rare occasions such as the zero bound era when interest rates do not move for years on end. So it is possible that both sides are right: That failing to act promptly will not lead to an unlimited inflation spiral, though inflation may well get worse before it gets better, and that the Fed could lower inflation in the near term with interest rate rises. My sense of empirical work also points to substantially higher price stickiness than I used to make sense of the Fed's forecasts, which leads to a longer adjustment period.

For the rest of this paper, I adopt the new-Keynesian, rational expectations version of the model. I adopt it as a working hypothesis, not immutable truth. Let us figure out what it says about how inflation will evolve, what the effects are of Fed policies, and how inflation might be ended if it gets out of control. I also adopt as working hypothesis view that fiscal constraints matter now as they might not have mattered in the past. The fact that this inflation was fairly clearly sparked by fiscal policy, and large debts and ongoing deficits matter. Alternate views will give alternate predictions.

4 Inflation persistence and unpleasant arithmetic

How long will inflation last? Even granting the Fed's rational expectations view, the dynamic response to sticky prices give a certain momentum to inflation. It is *not* true that once you remove the stimulus, inflation stops on a dime.

Related, how does inflation respond dynamically to a fiscal shock? The standard new-Keyensian model posits passive fiscal policy, so there is no such thing as a fiscal shock. Here I adapt that model to include a fiscal shock, and study the persistence of that shock.

4.1 Flexible Prices

Start with completely flexible prices, to illustrate absence of momentum.

$$i_t = E_t \pi_{t+1} \tag{4}$$

$$\rho v_{t+1} = v_t + i_t - \pi_{t+1} - \tilde{s}_{t+1}. \tag{5}$$

The variable v is the real value of government debt, $\rho = e^{-r}$ is a constant slightly less than one, and $\tilde{s}$ is the real primary surplus scaled by the value of debt. Equation (5) is a linearized version of the debt accumulation equation: The real value of debt increases by the real interest rate or interest costs of the debt, and decreases by any primary surpluses.

I analyze a shock to surpluses $\tilde{s}_t$, and I start by specifying no change to the interest rate i_t. I'll add a stronger monetary policy response later.

We can iterate forward (5) , take $\Delta E_{t+1} \equiv E_{t+1} - E_t$ of both sides, use (4), to get

$$\Delta E_{t+1}\pi_{t+1} = -\Delta E_{t+1}\sum_{j=0}^{\infty}\rho^j \tilde{s}_{t+1+j} = -\varepsilon_{s,t+1}. \tag{6}$$

Unexpected inflation is the revision in the present value of surpluses. Thus, the solutions of this model are

$$i_t = E_t\pi_{t+1}$$
$$\Delta E_{t+1}\pi_{t+1} = -\varepsilon_{s,t+1}.$$

The interest rate sets expected inflation; the fiscal shock drives unexpected inflation.

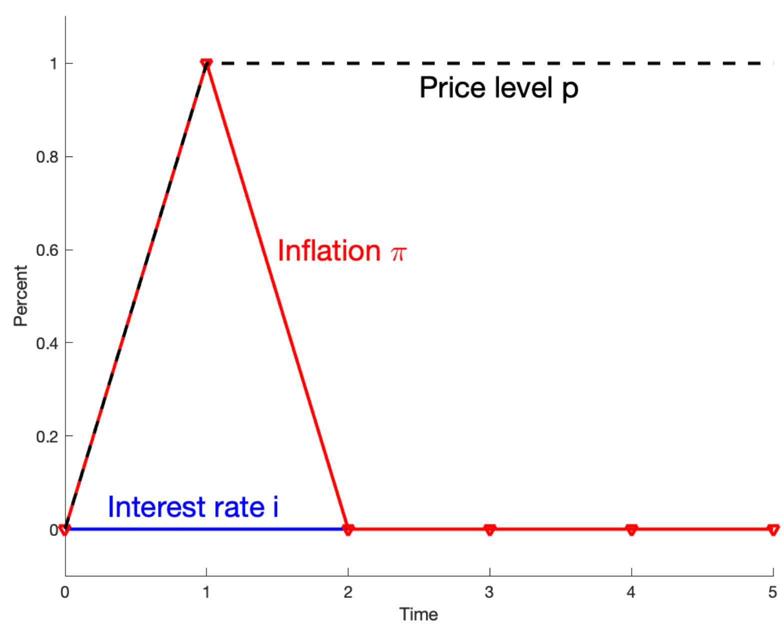

Figure 9: Response to a fiscal shock, frictionless model.

Figure 9 plots the response to a 1% deficit shock with no change in the interest rate. The result is a 1% unexpected price-level rise; a 1% transitory inflation.

If this is the model, and if this is the shock, and the shock is over, inflation will soon end. We only have to decide what a "period" is.

Now, the \$5 trillion cumulative deficit was almost 30% of the \$17 trillion in debt outstanding at the beginning of the pandemic. We have seen only about 10% price level rise so far (Jan 2021 to March 2022 CPI), of which perhaps 2% was expected. But the inflationary fiscal shock is the shock to the discounted sum of deficits and surpluses in (6), not just the shock to today's deficit. (This is a prime way in which a fiscal analysis differs from traditional Keynesian multiplier + gap analysis.)

So, if people expect most of the deficit to be repaid; if the 30% deficit (s_1) shock comes with 22% rise in future surpluses s_{1+j}, then we have only an 8% shock to the discounted stream of surpluses ε_s, resulting in the 8% unexpected price-level rise we have just seen. And it's over, at least until there is another shock to deficits, to people's expectations about that future partial repayment, or to monetary policy.

We do not know the size of the fiscal shock, because we do not know how much of the new debt people expect to be repaid. In the context of a model, however, we can measure the size of the fiscal shock from the observed inflation. As in the last section, conditioning on observed inflation, rather than calibrating the size of the shock and predicting the initial inflation, is the key novelty of these calculations. Rather than specify a fiscal shock and ask for the size and pattern of the resulting inflation, we look at the size of inflation and figure out how large the fiscal shock was.

While I think of this system in terms of fiscal theory, the same analysis applies if you think in strictly new-Keynesian terms. We observe the surplus/deficit and interest rate, so our question is what happens to equilibrium inflation given those paths. Who was active vs. passive in getting to that surplus and interest rate doesn't matter. You may view the situation that the Federal Reserve woke up and proclaimed a set of monetary policy disturbances and an active Taylor rule, that result in a sharp inflation though no change in observed interest rate—the $\phi\pi_t$ just offset the u_t in $i_t = \phi\pi_t + u_t$. (To calculate such a policy, first write the rule $i_t = i_t^* + \phi(\pi_t - \pi_t^*)$. Choose the i_t^* and π_t^* you want to see, then rewrite the rule with $u_t = i_t^* - \phi\pi_t^*$.) Then, fiscal policy "passively" accommodated this inflation with a large deficit. You may read (6) as a calculation of the "passive" fiscal consequences of such a Fed-chosen inflation. For many purposes, such as this one, one can be agnostic about equilibrium selection while analyzing monetary–fiscal interactions.

4.2 Sticky Prices

But prices are sticky, and sticky prices draw out the inflation response to a fiscal shock. I use the most standard new-Keynesian model, this time with a full dynamic IS curve:

$$x_t = E_t x_{t+1} - \sigma(i_t - E_t \pi_{t+1}) \tag{7}$$

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t \tag{8}$$

$$\rho v_{t+1} = v_t + i_t - \pi_{t+1} - \tilde{s}_{t+1}. \tag{9}$$

The response of this model to a unit deficit shock at time 1 is given by

$$\pi_t = (1 - \rho\lambda_1^{-1})\lambda_1^{-(t-1)}. \tag{10}$$

where

$$\lambda_1 = \left[(1+\beta+\sigma\kappa) + \sqrt{(1+\beta+\sigma\kappa)^2 - 4\beta}\right]/2.$$

Figure 10 presents the response of inflation to the same deficit shock as in Figure 9, with no interest rate response, but now with sticky prices. *Sticky prices draw out the inflation response.*

The total rise in the price level is the same, 1.0, but it is spread over time. In essence, the frictionless model of Figure 9 does describe the fiscal shock, but a "period" is 7 years.

If this graph is right, we have a good deal of inflation left to go. The first year only produces about 40% of the total eventual price level rise. In this interpretation, people do not expect the majority of the $5 trillion deficit, 30% of debt to be repaid. Again, in this exercise we *observe* initial inflation, and *infer* the size of the fiscal shock, which depends on otherwise difficult to observe expectations of repayment. And despite no response at all from interest rates, inflation is stable and eventually goes away on its own—this now completely standard new-Keynesian model

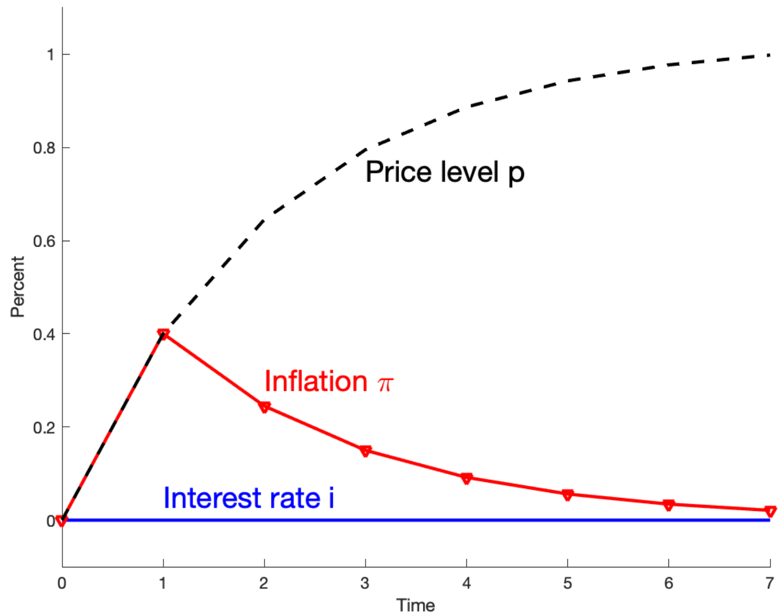

Figure 10: Response to a deficit shock equal to 1% of outstanding debt. Sticky prices with no monetary policy response. Parameters $\sigma = 1$, $\kappa = 0.25$, $\beta = 0.99$, $\rho = 0.98$.

does express the sign, if not the speed, of the Fed's projections.

The conclusion depends on parameters, and especially on the product of intertemporal substitution times price stickiness $\sigma\kappa$. If prices are much less sticky than I have specified, these dynamics might describe a period of two years, as the Fed seems currently to believe. (This is essentially the same calculation as the bottom rational expectations panel of Figure 6, but with a full IS curve.) But $\kappa = 0.25$ is if anything less sticky than typical specifications. $\kappa = 0.25$ means that a 1% GDP gap and steady expectations $E_t\pi_{t+1}$ implies 0.25% inflation; by Okun's law a 1 percentage point decline in unemployment implies 0.5% inflation. This is if anything a good deal steeper, less sticky, Phillips curve than most studies find. More conventional price stickiness parameters lead to much more drawn out inflation.

With price stickiness, the fundamental story of a fiscal shock changes. In a flexible price model, we digest the plot simply: Unexpected inflation, an unexpected one-time price level increase, lowers the real value of outstanding debt, just as would a partial default. But this model still maintains one-period debt, so a slow expected inflation cannot devalue debt. Instead, in this model, there is a long period of negative real interest rates—as we are observing in reality. This period of negative real interest rates slowly lowers the real value of government debt. With sticky prices, even short-term bondholders cannot escape.

Given a 1% fiscal shock, the initial inflation is much lower with sticky prices. From (9), in this model we generalize (6) have

$$\Delta E_{t+1}\pi_{t+1} = -\Delta E_{t+1}\sum_{j=0}^{\infty}\rho^j \tilde{s}_{t+1+j} + \sum_{j=1}^{\infty}\rho^j (i_{t+j} - \pi_{t+1+j}) \tag{11}$$

The second term is a discount rate term. Lower real interest rates are a lower discount factor for government surpluses and raise the value of debt, an anti-inflationary force. Equivalently, lower real interest rates give a lower interest cost of the debt, that acts just like lower deficits to reduce inflation.

That price stickiness draws out the inflationary response to a fiscal shock is perhaps not that surprising. Many stories feature such stickiness, and suggest substantial inflationary momentum. Price hikes take time to work through to wages, which then lead to additional price hikes. Housing prices take time to feed in to rents. Input price rises take time to lead to output price rises. But such common stories reflect an idea of *backward* looking price stickiness. The Phillips curve in (8) is entirely forward looking. Inflation is a jump variable. Indeed, in the standard new-Keynesian solutions, inflation can rise instantly and permanently in response to a permanent monetary policy shock, with no dynamics at all. (Add $i_t = \phi\pi_t + u_t$, $u_t = 1.0u_{t-1} + \varepsilon_{i,t}$. Inflation and interest rates move equally, instantly and permanently to the shock.) Nonetheless sticky prices draw out dynamics.

One might well add such backward-looking terms, e.g.

$$\pi_t = \alpha\pi_{t-1} + \beta E_t\pi_{t+1} + \kappa x_t$$

and such terms are often used. (For example, Cogley and Sbordone (2008).) Such terms can add a hump-shaped response, and spread out even further the inflation response to the fiscal shock.

In sum, even with a completely rational expectations model, as the Fed seems to believe, inflation is likely to continue for some time. Even if we do not wish to disagree with the basic sign and stability of monetary policy and expectations, the parameters implicit in the Fed view seem pretty optimistic, in this simplistic analysis.

4.3 Monetary policy to fight inflation

The Fed will respond, however, so both our forecast and our advice should include such a response.

First, I ask, how might things have come out differently if the Fed had reacted more promptly? I continue to use the new-Keynesian model, giving the Fed the benefit of the doubt on that question.

To address that question, I add an interest rate policy rule and long-term debt to the model. The model is

$$x_t = E_t x_{t+1} - \sigma(i_t - E_t \pi_{t+1}) \tag{12}$$

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t \tag{13}$$

$$i_t = \theta_{i\pi} \pi_t + \theta_{ix} x_t + u_{i,t} \tag{14}$$

$$\rho v_{t+1} = v_t + r^n_{t+1} - \pi_{t+1} - \tilde{s}_{t+1} \tag{15}$$

$$E_t r^n_{t+1} = i_t \tag{16}$$

$$r^n_{t+1} = \omega q_{t+1} - q_t \tag{17}$$

$$u_{i,t} = \eta u_{i,t-1} + \varepsilon_{i,t} \tag{18}$$

This is a simplified version of the model in *Fiscal Theory of the Price Level* Section 5.5. The variable r^n_{t+1} is the nominal return on the portfolio of all government bonds. Equation (16) imposes the expectations hypothesis. Equation (17) relates the return of the government debt portfolio to the change in its price, where ω describes a geometric term structure of debt. The face value of maturity j debt declines at rate ω^j.

Long-term debt adds a mechanism by which higher interest rates can lower inflation, temporarily, while keeping rational expectations, consequent long-run stability, and the consequent implication that inflation eventually settles down.

We can think of the Fed's response in two ways: It may follow a rule that responds to inflation, raising $\theta_{i,\pi}$, or it may raise the interest rate as a persistent discretionary response, a shock ε_i. Since this is a rational expectations new-Keynesian model, following the Fed's evident beliefs, one must use $\phi_{i\pi} < 1$. This is not so unreasonable; evidence for $\phi_{i\pi} > 1$ is tenuous, as the graphs suggest. In the passive-fiscal new-Keynesian specification $\phi_{i\pi} > 1$ is an unobservable off-equilibrium threat; regressions in data from such a model would yield an estimate $\phi_{i\pi} < 1$ (Cochrane (2011)).

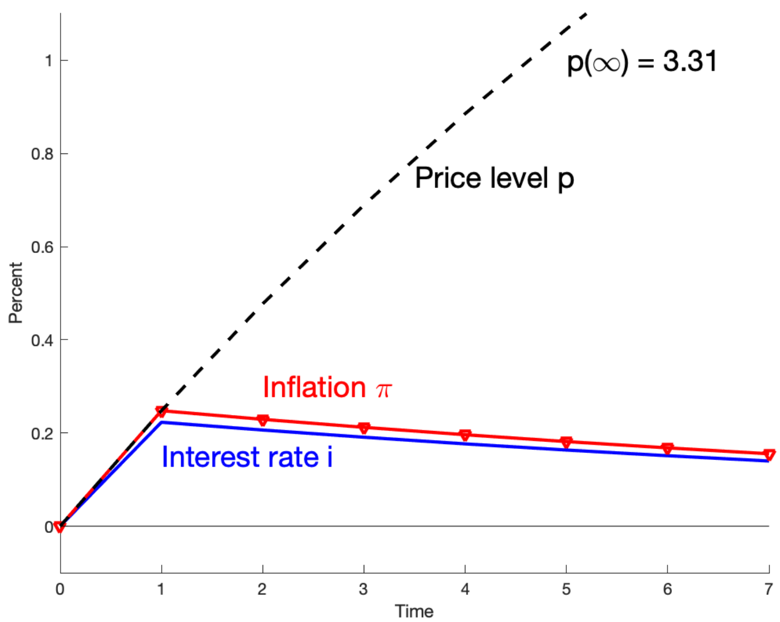

Figure 11: Response to a 1% deficit shock, with a monetary policy rule. Parameters $\sigma = 1$, $\kappa = 0.25$, $\beta = 0.99$, $\theta_\pi = 0.9$, $\theta_x = 0$, $\rho = 0.98$, $\omega = 0.8$.

Figure 11 presents the response of this mode to a fiscal shock. It answers the question, what would have happened if the Fed had acted promptly? It also answers, somewhat loosely, the question, how will inflation evolve if people think the Fed will move to such a rule in the near future? The interest rate now rises to a point just below the inflation rate, since I specified θ_π slightly less than one. The effect of this monetary policy response is to reduce the initial inflation impact of the fiscal shock, from about 0.4% to 0.25%, and to further smooth inflation over time.

However, though the graphs present the response to a 1% fiscal shock, we *observe* the initial 8% inflation shock and infer the size of the fiscal shock. If this is our world, we are only beginning to see the inflationary response to our one-time fiscal shock!

This graph and Figure 10 together make an important and more general point: *A one-time fiscal shock does not give rise to a one-time price-level jump. With sticky prices and monetary policy responses, a one-time fiscal shock gives rise to quite long-lasting persistent inflation.*

4.4 Unpleasant interest-rate arithmetic

The graph captures one aspect of current intuition: By raising interest rates, the Fed lowers near-term inflation from what it otherwise would be. But this model describes a form of unpleasant arithmetic: Inflation is more persistent, so later inflation is larger. Sims (2011) called this pattern "stepping on a rake," and offered it as a diagnosis of the 1970s. Interest rate hikes initially quell inflation but without a coordinated fiscal tightening, they raise later inflation.

There has been a fiscal shock, a deficit that will not be repaid. At some point some debt must be inflated away as a result of that deficit. Monetary policy here can shift inflation around over time; it can smooth inflation, which is desirable in this and most other models of the Phillips curve. But monetary policy cannot eliminate a fiscal inflation entirely.

In fact, the cumulative inflation in this model is 3.38%, three times *larger* than the 1% cumulative inflation of the last two models. The Fed in this simulation spreads inflation forward to fall more heavily on long-term bond holders, whose claims are devalued when they come due, and thereby lightens the load on short-term bondholders, who do not experience much inflation. But the mechanical rule spreads inflation forward even further than that, as the maturity structure of the debt, with coefficient 0.8 is shorter than this inflation response. A more sophisticated rule could achieve the same reduction in current inflation with a smaller total price-level rise. For now, if this is our world, not only will we see the nearly 30% total price level rise suggested by the previous model, we will see a total price level rise nearly three times greater.

Moving inflation to the future might also give some breathing space for fiscal policy to reverse, for Congress and administration to wake up and solve the long-run budget problem, or to hope for an opposite fiscal shock. They don't seem in much mood to do so at the moment, but if inflation persists and its fiscal roots become more apparent, that mood may change.

To isolate what the Fed can do about inflation, Figure 12 plot the response of inflation to a persistent monetary policy shock, *holding fiscal surpluses or deficits constant*. Conventional new-Keynesian responses to monetary policy shocks include strong "passive" fiscal policy responses. But that's not interesting here. We have had a fiscal policy shock, and as we look forward fiscal constraints on monetary policy will loom. The question for the Fed now is, what can it do to address inflation *without* counting on a substantial fiscal policy response to its moves. For this calculation I do not also include Taylor-rule responses. All that matters to inflation is the path of the interest rate, so how we get there by a shock or endogenous responses does not matter.

The model is linear, so to ask how inflation will evolve in the near term if the Fed tightens, we superimpose this response on the response of the economy to the fiscal shock with no change in monetary policy, Figure 10. Figure 12 tells us how the Fed might modify the depressing persistent inflation of Figure 10.

The higher interest rate in Figure 12 lowers inflation. It also lowers output, as inflation is lower than future inflation. But inflation slowly creeps back up again, and inflation is higher in the long run. This long-run rise would be easy to miss in an estimated impulse-response function, and estimates have not tried to orthognonalize monetary and fiscal shocks. This graph shows more clearly how, without modifying fiscal policy, the Fed can only move inflation around, buying lower inflation in the short run with higher inflation in the long run. Uniformly lower inflation requires a fiscal tightening, to pay a windfall to bondholders. Thus, Figure 12 represents a form of unpleasant arithmetic, to use Sargent and Wallace's 1981 memorable phrase. There is no money in this model, so it is unpleasant arithmetic of interest rate policy.

Equation (15) which I repeat for convenience,

$$\rho v_{t+1} = v_t + r^n_{t+1} - \pi_{t+1} - \tilde{s}_{t+1}$$

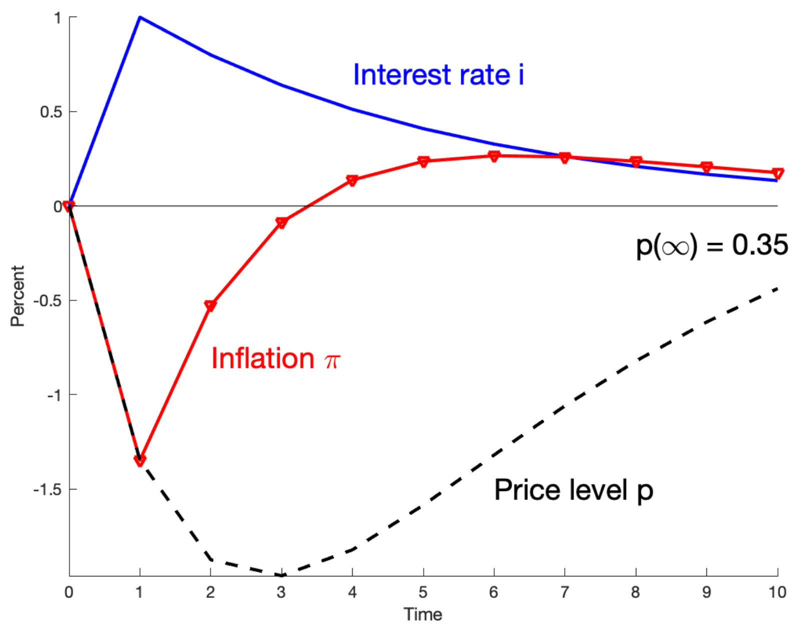

Figure 12: Unpleasant Arithmetic. Response to a monetary policy shock with no change in surplus or deficit. Parameters $\sigma = 1$, $\kappa = 0.25$, $\beta = 0.99$, $\theta_\pi = 0$, $\theta_x = 0$, $\rho = 0.98$, $\omega = 0.8$, $\eta = 0.8$.

describes the evolution of government debt in this more general model, with long-term debt. Iterating forwards, it implies

$$v_t = \sum_{j=1}^{\infty} \rho^{j-1} \tilde{s}_{t+j} - \sum_{j=1}^{\infty} \rho^{j-1} r_{t+j}.$$

The real value of debt is the present value of real primary surpluses, discounted here by the expected real return on the portfolio of government bonds. Taking innovations, we obtain a generalized version of identity (6),

$$\sum_{j=0}^{\infty} \omega^j \Delta E_{t+1} \pi_{t+1+j} = -\sum_{j=0}^{\infty} \rho^j \Delta E_{t+1} \tilde{s}_{t+1+j} + \sum_{j=1}^{\infty} (\rho^j - \omega^j) \Delta E_{t+1} r_{t+1+j}, \tag{19}$$

where $r_{t+1} \equiv r^n_{t+1} - \pi_{t+1}$ is the ex-post real return on the portfolio of government bonds. (Cochrane (2022b) Section 3.5.) Unexpected inflation, now summing current and expected future inflation, weighted by the maturity structure of government debt, devalues government bonds, and unexpected deflation raises their value. That inflation must correspond to a change in expected primary surpluses, or a change in the discount rate. Equivalently, higher interest costs on the debt in the last term act just as lower surpluses in the second term; higher interest costs on the debt must be paid by higher surpluses if they are not to cause inflation.

Holding expected returns constant, given that there has been a negative fiscal shock, the first term on the right hand side, bondholders must lose. They might lose via inflation on the right hand side. With long-term debt $\omega > 0$, a change in expected future inflation can now devalue long-term bonds. The Fed can move those terms around, choosing more inflation now or more inflation later. But the Fed cannot alter the fact that there must be some inflation, now or later. The first term on the left-hand side expresses the sort of budget constraint for inflation now vs. inflation later that Sargent and Wallace made famous.

Bondholders can lose via the second term on the right hand side as well. This term is not present with flexible prices and in the absence of risk premiums in financial markets. But with sticky prices, more inflation can lower expected real bond returns. For example, with only one-period debt $\omega = 0$, (19) reduces to

$$\Delta E_{t+1}\pi_{t+1+j} = -\sum_{j=0}^{\infty}\rho^j \Delta E_{t+1}\tilde{s}_{t+1+j} + \sum_{j=1}^{\infty}\rho^j \Delta E_{t+1}(i_{t+j} - \pi_{t+j+1}) \tag{20}$$

If there is a fiscal shock, the Fed can no longer move the pain to long-term bondholders on the left hand side. But it can operate on the second term on the right hand side, making short-term bondholders lose the fiscal shock through a long period of low returns in future inflation, rather than a sudden devaluation on the left hand side.

This conclusion, of course, derives from the long-term debt mechanism that produces a temporary negative effect of interest rates on inflation. Other mechanisms, such as lags in the Phillps curve, financial frictions, and so forth, may produce a different effect.

5 How will inflation end?

Unpleasant arithmetic and monetary-fiscal coordination also pose some severe constraints on how inflation might end. They also remind us, however, of some hopeful analysis and episodes of how inflation can end swiftly without the pain of 1980.

Let us imagine a few more years have gone by, and inflation has continued, to 10% or similar levels, as it did by the late 1970s. And imagine that inflation is fully reflected in wage growth and in high nominal interest rates and bond yields. How can inflation be put back in the bottle?

Some of the basic points:

- Every successful disinflation has featured coordinated monetary, fiscal and microeconomic policy.
- That coordination will be crucial in a future US disinflation.
- Without fiscal coordination, a purely monetary approach to lowering inflation, based on higher interest rates, will fail.

Fiscal constraints will matter for a monetary disinflation. This inflation was, more clearly than the 1970s, sparked by a fiscal blowout. Fiscal policy remains stuck in persistent structural primary deficits, with unsustainable entitlement spending looming. Since 2008, we are cemented in a bailout/stimulus regime, that any significant shock will be met by larger and larger rivers of borrowed or printed money. Any shock – and there will be shocks – will likely create additional fiscal shocks. Thus, if inflation continues, that event will likely be the result of additional fiscal shocks. That prognosis is especially in the rational-expectations view of the world, in which absent fiscal shocks or deliberate monetary inflation, inflation would disappear on its own. Monetary policy will operate in the shadow of 100% of GDP debts, 5% of GDP primary deficits, growing entitlement gaps, and, 30% of GDP blowouts in each shock.

How will fiscal policy constrain monetary policy? There are three main channels. First, of course, the government loses seignorage revenue. This is the most classic form of fiscal-monetary interaction, stressed by Sargent and Wallace (1981) famous "unpleasant arithmetic." But seignorage is close to irrelevant today. Two other channels are much more important, .

Second, higher interest rates raise interest costs on the debt. Suppose the Fed were to raise interest rates 5%. We have 100% debt to GDP ratio, and rising. 5% interest rates means 5% of GDP interest cost, $1 trillion dollars per year of extra deficit. It means that the monetary contraction must come with $ trillion per year fiscal contraction as well. If it does not, then the fiscal forces behind inflation get worse. (That our government has sadly chosen primarily to roll over short term debt, and the Fed has chosen to further shorten the maturity structure by buying trillions of long debt and turning it into overnight debt means that interest costs flow much more quickly on the budget than they would otherwise do, strengthening this channel.)

Third, disinflation is a windfall to bond holders. That windfall must also be paid, an additional expense requiring fiscal contraction. At 100% debt to GDP, a 10% disinflation requires 10% of GDP to be transferred from taxpayers to bondholders. For the moment, long-term bond yields have not risen to match inflation, so a golden opportunity still remains to disinflate without this fiscal cost.

The latter two effects are captured by the identity (19), which I repeat for convenience,

$$\sum_{j=0}^{\infty}\omega^j \Delta E_{t+1}\pi_{t+1+j} = -\sum_{j=0}^{\infty}\rho^j \Delta E_{t+1}\tilde{s}_{t+1+j} + \sum_{j=1}^{\infty}(\rho^j - \omega^j)\Delta E_{t+1} r_{t+1+j}.$$

To disinflate, a negative term on the left hand side, we must have increased fiscal surpluses, the first term on the right hand side. If that disinflation comes with higher expected returns on government debt, the third term on the right hand side, the rise in surpluses must be that much larger.

1980 was not just a monetary disinflation. It was a joint monetary, fiscal and microeconomic reform. The monetary contraction of the early 1980s was quickly followed with two tax reforms, in 1982 and 1986, that dramatically slashed marginal rates, while broadening the base. The 1991 tax change raised marginal rates, but not back to earlier levels. Deregulation was at least aimed at increasing economic growth. Whether for these or just good luck, economic growth rose, tax revenues rose, and so did surpluses.

Figure 13 presents the real primary surplus through the 1980s and 1990s. Despite the much commented on “Reagan deficits,” *primary* deficits were not that large in the Reagan years. Most of the reported deficit was sharply higher interest costs due to the higher interest rates. I include the negative of the unemployment rate, to allow

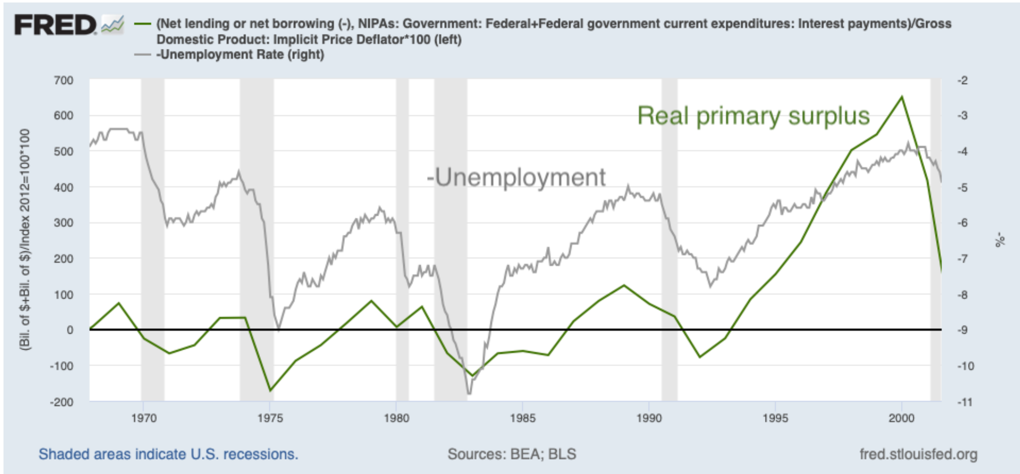

Figure 13: Real primary surplus and negative unemployment rate 1980-2000. Primary surplus is Federal net lending or borrowing plus federal interest payments, converted to 2012 dollars via GDP deflator.

an ocular business cycle adjustment. Adjusted for the recession, the deficits of the early 1980s are again at least no worse than 1975. (I plot the surplus itself, not the surplus to GDP ratio. It is actual surpluses that pay off debts. A valuation formula in terms of the surplus/GDP ratio adds GDP growth, so we see the source of the surpluses more directly.)

But the main point, starting in 1982 and 1986, the US entered a period of strong primary surpluses that lasted until 2000. At least with ex-post wisdom, the disinflation of 1982 corresponded to a strong *fiscal* contraction, a rise in in the *present value* of surpluses. Cochrane (2019) decomposes the value of government debt to make a calculation and an ex-ante calculation using VAR methods.

Interest costs on the debt rose, posing a fiscal headwind. The rise in surpluses was strong enough to overcome that rise in interest costs as well. Investors who bought 10 year bonds at 15% yield in 1980, expecting inflation, got repaid in an environment of 3% inflation. That windfall came courtesy of the US taxpayer.

Figure 14 plots the debt to GDP ratio. That ratio rises with deficits and also with higher interest payments on the debt. We see the continued rise in debt/GDP in the 1980s due to interest costs, but that the strong surpluses of the 1990s paid those

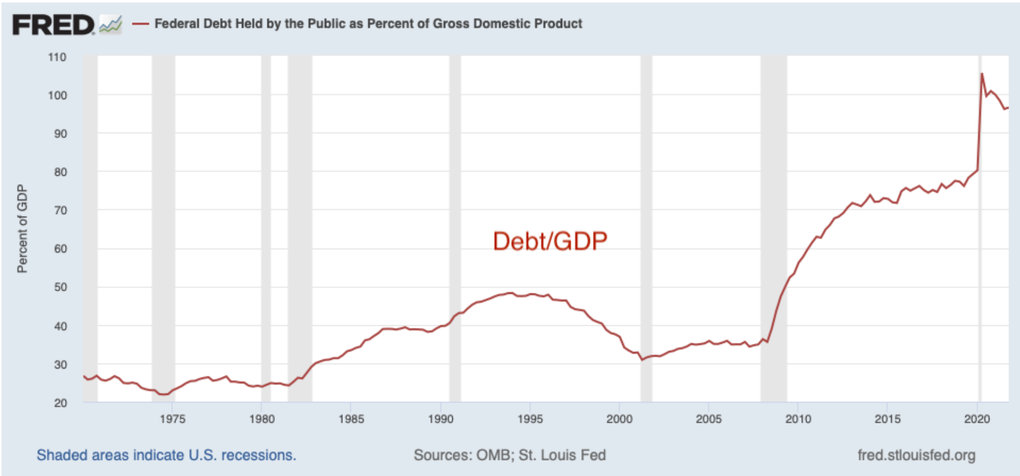

Figure 14: US debt to GDP ratio.

interest costs as well.

Did people know this would happen? What gave them confidence that the US would in fact pay off its debt at the much larger value implied by disinflation? Something did, and that expectation was right. Ex-post, at least, 1980 was a joint monetary, fiscal, and microeconomic reform.

Contrary episodes abound in Latin American history (Kehoe and Nicolini (2021)). Inflation surges, usually caused by intractable deficits; the central bank attempts a monetary stabilization; which slows inflation for a while; the underlying fiscal problem is not solved, however, and inflation comes back more strongly. In particular, higher interest costs on the debt with no corresponding fiscal reform can lead to higher inflation quickly. The US had a monetary reform that was followed by fiscal and microeconomic reform – the latter growing the tax base. There were a few years of high interest rates in between. One might read the recession and period of high interest rates as a period of uncertainty whether the needed fiscal reforms and growth would indeed occur.

The US is now stuck in a period of sclerotic long-run GDP growth; cut roughly in half starting in the year 2000, and consequent slower growth in tax revenues. In 1980, the debt to GDP ratio was 20%. It is now 100% and rising, with steady structural deficits, unfunded entitlements, and a regular blowout in each crisis awaiting us.

The fiscal constraints on monetary policy will be at least four times larger this time.

One-time reversible "austerity" does not solve the fiscal problem. Equation 19 reminds us that a disinflationary reform needs to last decades; it must raise the *present value* of future *surpluses*; tax revenue less spending. Nothing transitory or reversible will work at all. And raising distortionary tax rates, which may take a decade or two to translate to lower growth, is at least climbing up a sand dune: even on the left side of the Laffer curve, there is some behavioral response yielding less revenue, and less growth, for each rise in tax rate.

Without fiscal coordination, an interest rate rise will fail to control inflation. Equation 19 is an identity. To make this point concrete, Figure 15 graphs the results of an interest rate rise in a perfectly standard new-Keynesian model – no fiscal theory funny business here. (This figure, calculation and discussion are adapted from Cochrane (2022b) Chapter 17.)

The model is the standard new-Keynesian model

$$
\begin{aligned}
x_t &= E_t x_{t+1} - \sigma(i_t - E_t \pi_{t+1}) \\
\pi_t &= \beta E_t \pi_{t+1} + \kappa x_t \\
i_t &= \phi \pi_t + u_t
\end{aligned}
$$

Fiscal policy is passive, providing whatever surpluses are needed to validate inflation chosen by monetary policy is. I use the unexpected inflation identity (19), to solve for the needed passive fiscal policy of surpluses, and using $r_{t+1} = i_t - \pi_{t+1}$. The only innovation from standard new-Keynesian analysis is to look at the required fiscal contraction that accompanies a monetary tightening.

Suppose the Fed raises interest rates by a positive and serially correlated disturbance u_t. Figure 15 presents the result. The figure presents a surprise AR(1) rise in the interest rate, with serial correlation $\eta = 0.6$, a standard transitory monetary policy experiment.

However, there are multiple disturbance paths $\{u_t\}$ that produce the same interest rate path but different inflation paths. In each case, I reverse engineer a $\{u_t\}$ disturbance to produce the same AR(1) interest rate path, and a chosen value of initial inflation π_1.

Start in the top-left panel. I choose the disturbance $\{u_t\}$ to produce the AR(1)

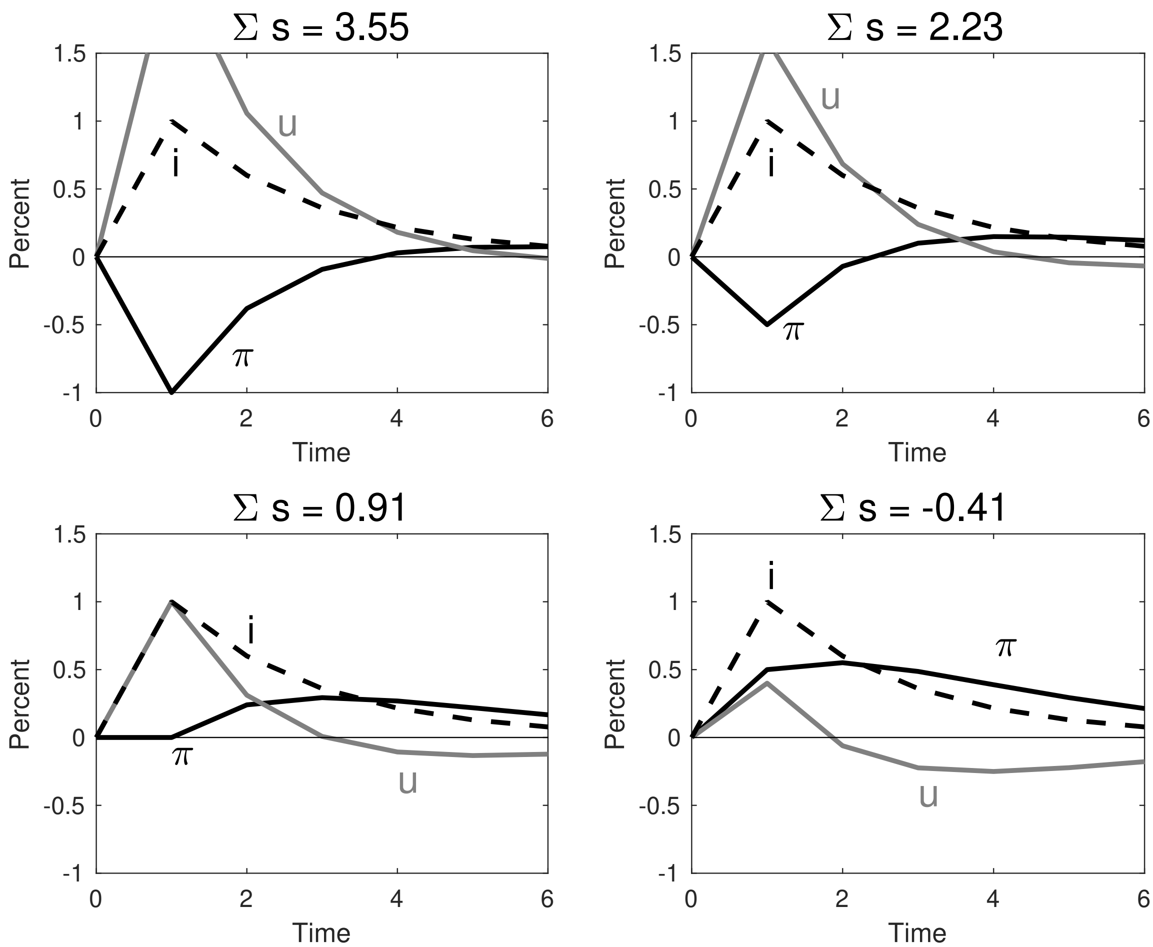

Figure 15: Inflation response to an interest rate rise. Each panel presents a different choice of the disturbance u_t which produces the same interest rate path. The title $\Sigma s =$ ... gives the percent change in the sum of surpluses required by passive fiscal policy for each case. Parameters are $\eta = 0.6$, $\sigma = 1$, $\kappa = 0.25$, $\beta = 0.95$, $\phi = 1.2$.

interest rate and a -1% initial inflation. This panel gives the standard new-Keynesian result: A higher interest rate lowers inflation, here by exactly 1%. The disturbance u_t follows an AR(1)-like process. It moves more than the interest rate, since $\phi\pi$ and negative inflation drag the actual interest rate down below the disturbance u_t.

Fiscal policy is passive, but the fiscal response has to happen. In this case, as reported in the figure title, cumulative surpluses have to rise 3.55 percentage points of GDP. (I use $\rho = 1$ and 100% debt-to-GDP ratio.) Surpluses have to rise one percentage point of GDP to pay the 1% deflationary windfall to bondholders. They have to rise an additional 2.55 percentage points of GDP because of the long period of high real interest rates, which you can see from a higher i_t line than π_t line, which represent a higher discount rate or higher real interest costs of the debt.

Multiplying by 5, a 5 percentage point interest rate rise and 5 percentage point disinflation require an 18% of GDP austerity program, $4 trillion. Will the administration and Congress passively accede to this request? If they do not, the attempt must fail; the path is not an equilibrium.

What can the Fed do differently? It can follow a different disturbance $\{u_t\}$ that produces the same interest rate path, but requires less fiscal support. In the top right panel, I reverse engineer a disturbance u_t that produces the same interest rate path, but only -0.5% disinflation. The disturbance is smaller and has different dynamics. Since this disturbance produces less disinflation, it also requires less fiscal austerity, 2.23 percentage points of GDP rather than 3.55 percentage points. But for a 5% interest rate rise, this path still requires Congress and the administration to cut back by $5 \times 2.23 = 11.5$ percent of GDP, or $2.2 trillion dollars.

In the lower left-hand panel, I reverse engineer a disturbance u_t that produces the same interest rate path, but produces no disinflation at all. Though interest rates follow the same AR(1), inflation starts at zero and then slightly *rises.* But this path still requires passive fiscal policy to turn to austerity, by 0.91 percentage points of GDP. Higher real interest rates still provoke a discount rate effect, or higher real interest costs, which surpluses must overcome.

In the bottom-right panel, I reverse-engineer a disturbance process u_t that produces +0.5% inflation, along with the same interest rate path. This time passive fiscal policy includes a slight fiscal loosening. Congress and administration cheer, but we clearly have done nothing to fight inflation.

The lesson of this example is that in the stock new-Keynesian model, thought of and solved in completely new-Keynesian fashion, the same interest rate path may or may not cure inflation. For a higher interest rate to disinflate, it must be accompanied by fiscal contraction. If that contraction does not or cannot happen, the Fed cannot lower inflation by raising interest rates.

5.1 Happier scenarios

We take for granted that if inflation does become embedded, a disinflation must involve a 1980s style recession. Let us remember the much happier possibilities, considered then and verified since. Again, that possibility is embedded in a Phillips curve driven by expectations of future inflation – that at least in times of big reforms, the anchor point of the Phillips curve can move rapidly.

Inflation targets have been remarkably successful. Figures 16 and 17 show inflation around the introduction of inflation targets in New Zealand and Canada. On the announcement of the targets, inflation fell to the targets quickly, and stayed there, with no large recession, and no period of high interest rates or other monetary stringency, such as occurred during the painful U.S. and U.K. stabilizations of the early 1980s. Sweden had a similar experience. Just how were these miracles achieved?

These episodes are the introductions of inflation targets. Now, inflation targets consist of more than just promises by central banks, or a deal between central banks and politicians. Central banks and politicians make announcements and promises all the time, which people take with with skepticism well-seasoned by experience.

Inflation targets are an agreement between central bank, treasury, and government. Yes, they instruct central banks to worry about inflation and thereby not to worry about other things. The point of a mandate is as much or more that central banks must ignore what is outside the mandate as it is to pay attention to what is in the mandate. But inflation targets are also commitments by treasurys and governments, and specifically a commitment—implicit or explicit—to run fiscal policy so as to pay off nominal debt at the agreed-to inflation target, no more and no less, and to raise surpluses so as to pay any interest costs on the debt that may result from central bank monetary policy. These *fiscal* and *microeconomic* commitments are as important to inflation stability as is the central bank's *monetary* commitment.

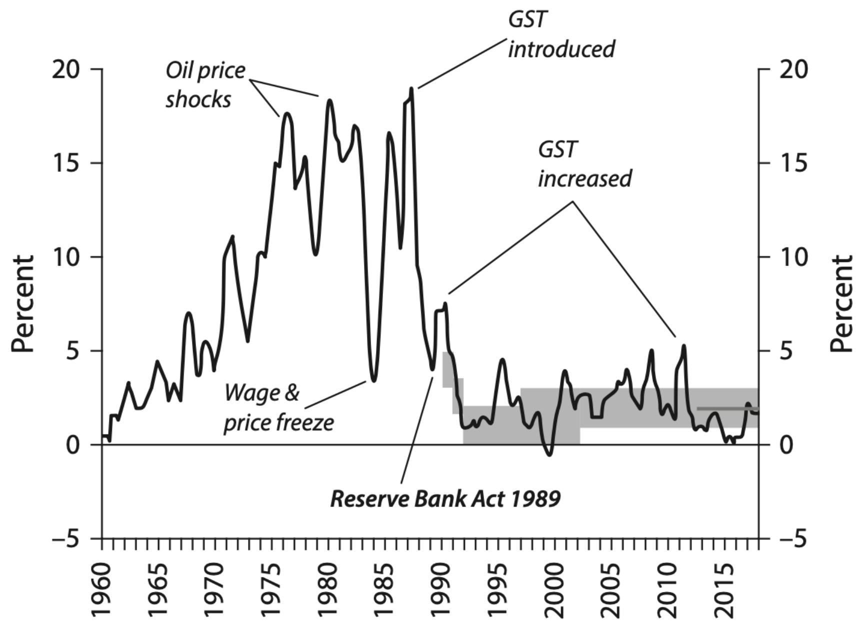

Figure 16: Inflation Surrounding the Introduction of a Target in New Zealand. Shading indicates the inflation target range. Source: McDermott and Williams (2018). Figure courtesy of Rebecca Williams.

The inflation target functions as a gold price or exchange rate target, which commit the legislature and treasury to pay off debt at a gold or foreign currency value, no more and no less. But the inflation target aims at the CPI directly, not the price of gold or exchange rate, eliminating that source of relative price variation.

Figure 16 provides evidence of this view, with the annotation "GST [goods and services tax] introduced" and "GST increased." The inflation targets emerged as a part of a package of reforms including fiscal reforms, spending reforms, financial market liberalizations, and pro-growth regulatory reforms. McDermott and Williams (2018).

That fact accounts for their near-miraculous success. One would have thought, and most people did think, that the point of an inflation-targeting agreement is to insulate the bank from political pressure during a long period of monetary stringency. To fight inflation, the central bank would have to produce high real interest rates and a severe recession such as accompanied the U.S. disinflation during the

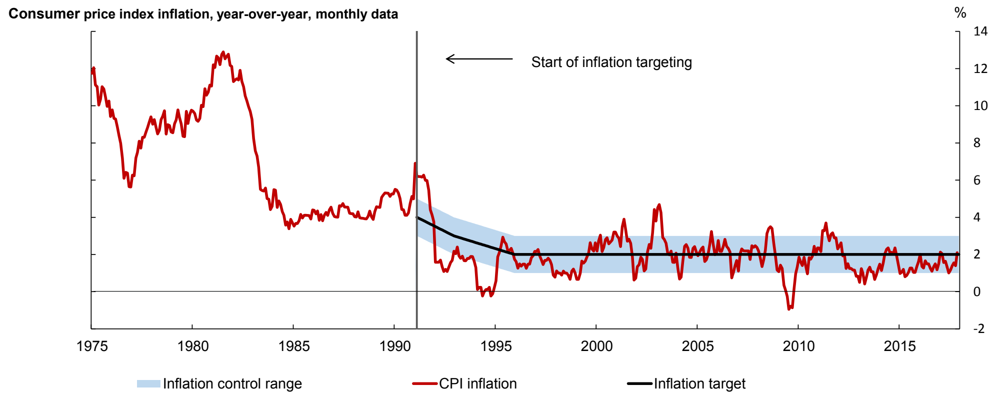

Figure 17: Inflation Surrounding Canada's Introduction of an Inflation Target. Source: Murray (2018).

early 1980s. And the central bank would have to repeat such unwelcome medicine regularly.

Nothing of the sort occurred. Inflation simply fell like a stone on the announcement of the target, and the central banks were never tested in their resolve to raise interest rates, cause recessions, or otherwise squeeze out inflation. Well, "expectations shifted" when the target was announced, and became "anchored" by the target, but why? Because the targets came with a new and durable *fiscal* and *microeconomic* regime, that cured the fiscal problems underlying inflation in the first place.

An inflation target failed instructively in Argentina 2015-2019. In the analysis of Cachanosky and Mazza (2021) and Sturzenegger (2019), the basic problem was that the necessary fiscal commitment was absent. Argentina's failure reinforces my point that a successful inflation target is as much a commitment by treasury as a commitment by and commandment to the central bank.

This success of inflation targets is in this reading an application of the classic Sargent (1982) analysis of the ends of inflations. When the long-run *fiscal* problem is credibly solved, inflation drops on its own, almost immediately. There is no period of monetary stringency, no high real interest rates moderating aggregate demand, no recession. Interest rates fall, money supply may rise, and deficits may rise temporarily as well, with the government newly able to pledge surpluses. As such, inflation targeting episodes are as revealing about lack of mechanical stickiness in expectations, specifically in the Phillips curve, as they are about the fiscal foundations of those inflation expectations.

But as Sargent reminds us, expectations do not shift on forward guidance promises. Speeches and WIN buttons do not shift expectations. People need to see the regime has changed.

We are in danger of losing this history. Clearly, in much contemporary monetary policy, the conventional lessons of the 1970s and 1980s in the US has been somewhat forgotten. But let us also not forget the wider lessons of history, and the durable lessons of the rational expectations revolution. *An economically painless disinflation is possible, if it combines fiscal, monetary, and microeconomic reforms, that constitute a new and fiscally sound regime.* I qualify as economically painless because it certainly is not politically painless. The sort of tax reform, social program reform, and regulatory reform needed to straighten out US fiscal and monetary affairs are simple for us to design, but would be political suicide in today's environment. Perhaps, as in the late 1970s, or in the inflation targeting countries, enough inflation and stagnation will change that political consensus.

Finally, forward-looking models point to a relatively painless way to end inflation, if one is patient enough. In all of the forward-looking models, the economy is stable, so inflation eventually ends up moving towards nominal rates. If the Fed waits long enough, inflation will eventually come down to meet nominal rates. If the Fed raises rates to exploit the negative short-run relation, and then lowers rates again, inflation will come down to meet nominal rates. Inflation and nominal rates did fall together in the 1980s. This is an inescapable logical implication of the proposition that the economy is stable, the observation that inflation was stable at the zero bound, and a robust feature of models with forward-looking expectations. That does not make it practical advice. The long run is a long time. Other shocks can come along. It only works with no additional fiscal shocks, and people believe that existing debt, new deficits, and interest payments will be repaid by taxes. But it requires no additional fiscal tightening. In the long run, the central bank does, alone, control expected inflation.

6 Conclusion

All of this discussion presumes that the future will roll out like an impulse-response function, with no additional shocks. Perhaps we will be so lucky. That is unlikely.

War, nuclear war, a new or resurgent pandemic, financial turbulence including sovereign defaults lie in wait. Some shock will hit the economy within a decade. Here again the fiscal limits on monetary policy loom large. We are firmly in the bailout regime, that any shock is met by trillions of borrowed or printed dollars, to bail out creditors, prop up asset prices, and float the economy with stimulus. We just found the limits of that approach – people don't want to hold all the new debt, do not believe it is a good investment, and are spending it, driving up prices.

The danger of our fiscal and monetary situation, then, is that we have lost fiscal and monetary space to react to a shock. If the government wants to borrow or print another $5 trillion, and nobody wants to hold the debt, either inflation or a debt crisis erupt immediately.

In stating this view I raise another central theoretical question. Is the limit of fiscal policy a *flow* or a *stock* limit? As I have posed it, inflation breaks out when the quantity of *debt* exceeds people's expectations of repayment.

Two fundamental questions underlie most of these questions: First, are expectations forward-looking or backward-looking? That really determines whether the Fed must raise interest rates aggressively to avoid adding monetary inflation to the fiscal impulse. Forward looking expectations are tough and cynical though – speeches are not enough to anchor expectations. Second, is the fiscal limit a flow or a stock? As I have analyzed it, inflation occurs when people lose faith that the government can repay its debt. In a more conventional analysis, such as I read in to Larry Summers' prescient editorials on inflation, excess fiscal stimulus comes from an excess *flow* of debt, from current deficits that through a multiplier exceed the GDP gap. Once that flow settles down, however, the stock of debt poses little danger. The needed monetary response, and the nature of future fiscal dangers and fiscal limits to monetary policy hinge on these two central economic questions.

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