CHAPTER THREE

Lessons from the Quiet Zero Lower Bound

SECTION ONE

The Radical Implications of Stable Quiet Inflation at the Zero Bound

John H. Cochrane

For nearly a decade in the United States, United Kingdom, and Europe, and for three decades in Japan, short-term interest rates have been stuck near zero, known as the "zero bound," because central banks can't lower interest rates substantially below zero. Central banks also embarked on immense open market operations. The US Federal Reserve bought nearly $3 trillion of bonds and mortgage-backed securities in return for newly created money. Bank reserves—essentially checking accounts that banks hold at the Fed—rose from $10 billion on the eve of the crisis in August 2008 to $2,759 billion in August 2014. Figure 3.1.1 summarizes the US experience.

The response to this important experiment in monetary policy has been surprising silence. Inflation is stable and if anything less volatile than before. Similar plots of GDP growth and

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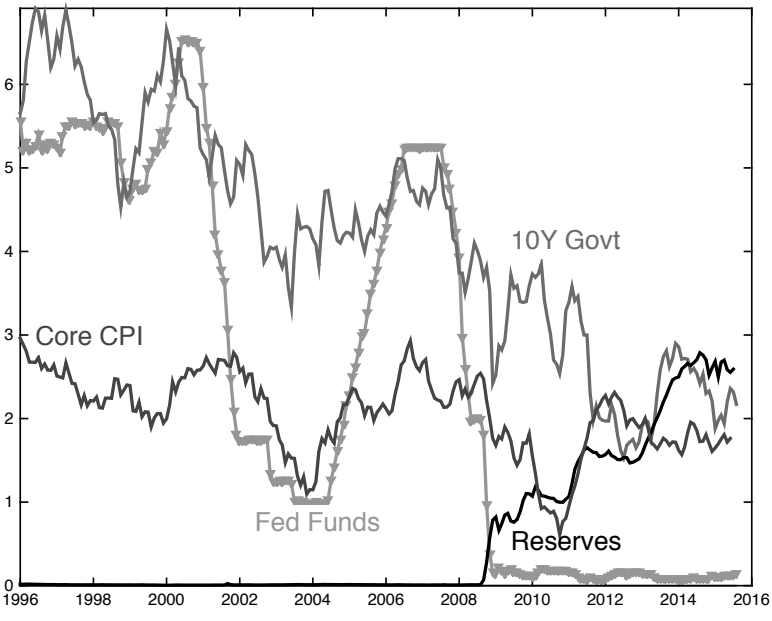

FIGURE 3.1.1. Recent US experience

unemployment show no large difference in the behavior of the economy during the time when interest rates were stuck near zero and not responding to economic conditions. The zero bound is not an obvious "state variable" for economic dynamics. Unemployment came down if anything a little quicker than in previous recessions. GDP growth, while too low in many opinions, has been if anything a little less volatile than before.

Existing theories of inflation make sharp predictions about the zero bound. Old Keynesian models, in use throughout the policy world, predict that inflation is unstable at the zero bound and, more generally, when interest rates cannot or do not move in response to inflation. These models predict a deflation spiral: Inflation goes down, so the real cost of borrowing money rises. That depresses the economy, inflation goes down more, the real cost of borrowing money rises more, and so on ad infinitum. Think of the Fed as a seal balancing a ball (inflation) on its nose. If the seal does not or

cannot quickly move its nose (interest rates), then the ball will fall off. It did not happen.

Monetarist theory that inflation fundamentally comes from increases in the quantity of money predicts that a massive increase in reserves must lead to galloping inflation. It did not happen.

Since the late 1980s, most academic work on monetary policy has been conducted in the framework of New Keynesian models. These models recognize that people make their decisions about what to do today thinking about the future, not the past. In economicspeak, they are "intertemporal" and feature "rational expectations." They also are fully specified economic models, obeying all the rules that well-posed models should obey. For example, they impose that people's plans to work, save, and spend are consistent. They impose budget constraints and market-clearing conditions.

Simple New Keynesian models predict that inflation is stable when interest rates do not move, and they predict that quantitative easing operations are irrelevant. The intuition is fairly straightforward. If a driver looks only in the rearview mirror, forming his expectations of the road ahead based on what lies behind, he will soon veer off the road. He needs a prescient Federal Reserve in the backseat to induce stability. If the driver looks forward, the car will return to the center of the road on its own, even if the Federal Reserve does no backseat driving. Likewise, from the perspective of modern finance, reserves at the Fed are indistinguishable from government debt. An exchange of short-term debt for reserves is like exchanging a $20 bill for two $10 bills. Without lots of extra "frictions," such an operation does not change overall spending.

Thus, the observed stability of inflation and apparent ineffectiveness of quantitative easing are big feathers in the New Keynesian cap. But they fail on quiet. Standard New Keynesian models predict that at the zero bound or when interest rates do not move, inflation jumps around randomly. The models have "multiple self-confirming equilibriums" or "sunspots" when interest rates do not move. If people expect inflation, inflation happens. These models

tie down expected inflation but not actual inflation. Think of a coin being flipped. Interest rate targets tie down the fact that on average half the flips will be heads. But the actual flips are a volatile mixture of heads and tails. In these models, when interest rates can move, the Fed can guarantee all heads or all tails and eliminate the random volatility.

This prediction that inflation is more volatile at the zero bound is a central component of the New Keynesian paradigm. The central empirical success of these models was explaining the greater volatility of inflation in the 1970s relative to the 1980s by such "sunspots," resulting from interest rates that did not move enough in response to inflation in the 1970s but did so in the 1980s. Two decades of New Keynesian research starting in the 1990s was devoted to devising means to escape the "zero bound" or "liquidity trap" of zero interest rates, precisely to avoid the reemergence of such "sunspots." Well, here we are, and the long-feared volatility did not happen. As Figure 3.1.1 emphasizes, instead of extra "sunspot" volatility, inflation is if anything quieter than before.

New Keynesian models also predict a menagerie of policy paradoxes when interest rates are stuck at zero: productivity improvements are bad, promises farther in the future have larger effects today, and reducing price stickiness makes matters worse, without limit.

One last theory remains. The fiscal theory of the price level states that inflation is fundamentally anchored by fiscal policy. In the end, the value of money comes from the government's commitment to accept its money, and only its money, for tax payments. If there is more government debt outstanding than people expect to be soaked up by tax payments, the value of that debt falls, and inflation breaks out.

More deeply, the fiscal theory proceeds from the observation that the real value of government debt must equal the present value of the primary budget surpluses that will eventually pay down that debt. If people think surpluses will not be sufficient to pay off the

debt, they will try to get rid of that debt by buying goods and services. This will drive up the price level, until the now-lower real value of the debt is equal to the lower value of expected surpluses. Nominal debt is, formally, just like stock in the government, with the price level as the stock price and the discounted value of surpluses as the discounted value of dividends.

This theory can be merged easily with the New Keynesian description of the rest of the economy, including its interest rate targets and sticky prices. The Fed, by setting interest rates, still determines expected inflation. But now fiscal policy determines the actual outcome—whether the coin comes up heads or tails. Each New Keynesian sunspot corresponds to a change in expectations about fiscal policy. With no big changes in fiscal policy (the present discounted value of future primary surpluses), there will be no sunspot volatility.

The resulting theory is consistent with stable quiet inflation at the zero bound. It also resolves the policy paradoxes of the New Keynesian model. This small change in ingredients has a large effect on the models' prediction for what we see and for the effects of policy.

Telling these theories apart was difficult before interest rates hit zero. Each offered a plausible account of the data up to that point. If a seal does a good job of balancing the ball, it's hard to tell if the ball is unstable and the seal is doing a great job, or if the ball is glued to the seal's nose. If someone holds the seal still, it's easier to tell. The zero bound period starting in 2008 offers a genuine and important experiment.

Theories fail sometimes in a dramatic manner. In the 1970s, prevailing Keynesian theory predicted little inflation, and the emergence of stagflation dramatically disproved that theory. In the 1980s, the same theory predicted that inflation would remain intractably high. The sudden disappearance of inflation in 1982–84 again proved it wrong. Theories fail no less when they unambiguously

predict a large inflation, deflation, or volatile inflation and nothing happens. It's just a lot less public.

DO HIGHER INTEREST RATES RAISE OR LOWER INFLATION?

What do this experience and theoretical interpretation imply about monetary policy going forward?

First, if inflation is stable when interest rates are stuck at zero, then it follows that if the central bank were to raise interest rates permanently, inflation must eventually *rise* to meet the higher interest rates. This reversal of the usual sign of monetary policy has become known as the "neo-Fisherian" hypothesis.

However, higher interest rates might still *temporarily* lower inflation before eventually raising it. The traditional belief that raising rates lowers inflation could still be right in the short run, and most evidence is about short-run correlations anyway. Is that possible? What do the models say?

It turns out the standard simple New Keynesian model, with or without fiscal theory, robustly predicts that a rise in interest rates produces a steady rise in inflation, with no temporary decline. It does produce an output decline—our central bankers are half right. Figure 3.1.2 illustrates.

This model produces a temporary inflation decline only if we pair the interest rate rise with a fiscal contraction: the fiscal contraction produces the temporary negative inflation, then the higher interest rates kick in to produce higher inflation.

That mixture may describe historical events—fiscal and monetary policy react to the same events—and therefore account for experience and econometric estimates. But if we define "monetary policy" as an increase in interest rates that does not come with a fiscal contraction, then our model still predicts that a future pure monetary policy interest rate rise will lead only to inflation.

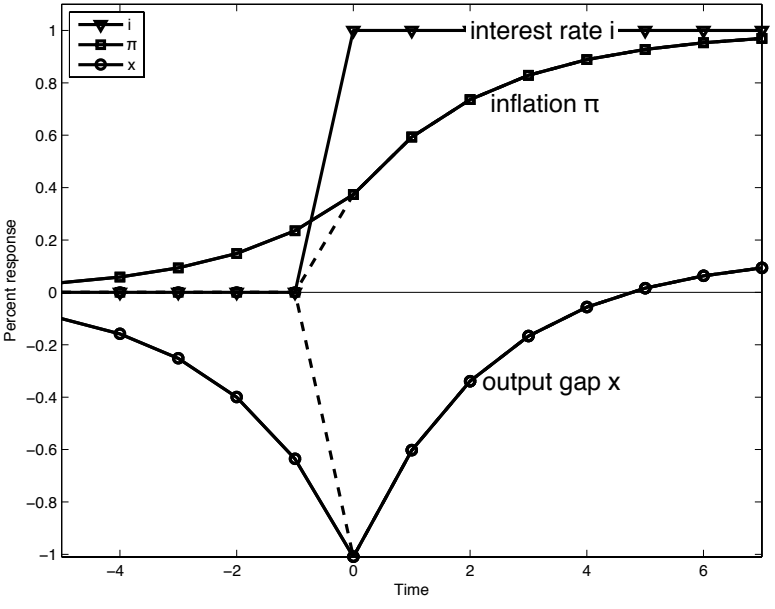

FIGURE 3.1.2. Response of inflation and output to a step function interest rate change in the standard IS-Phillips curve New Keynesian model. The solid lines show the response to an expected change. The dashed lines show the response to an unexpected change. Parameters $\beta = 0.97$, $\kappa = 0.2$, $\sigma = 1$.

I investigate what minimal set of ingredients it takes to produce a negative short-run impact of interest rates on inflation. The obvious candidates do not work: pricing frictions, adding money and monetary frictions to the model, even adapting classic backward-looking Phillips curves. With any forward-looking behavior, higher interest rates mean higher inflation. It is simply not true to say, "Sure, in a frictionless model higher rates mean higher inflation, but since prices are sticky / the real world has money in it / price setting seems to look backward, higher rates temporarily lower inflation." They don't.

One ingredient can robustly and simply produce the desired temporary negative sign. If we add long-term debt, a rise in interest rates can produce a temporary decline in inflation. In brief, when

the Fed raises interest rates and communicates that interest rates will be higher for some time in the future, long-term bond prices fall. In that case, the total market value of the debt falls. But if the Treasury does not make any change in fiscal policy, then the real value of debt has not changed. We have an imbalance. Treasuries are worth more than their market price. People try to buy more Treasuries and buy less goods and services to get them. But with the supply of Treasuries fixed and their price (interest rate) fixed, the lower aggregate demand for goods and services pushes the price level down. Once the price level has fallen, the higher inflation corresponding to higher interest rates can take over.

Figure 3.1.3 illustrates this mechanism. Here I plot the response to a permanent one percentage point increase in interest rates,

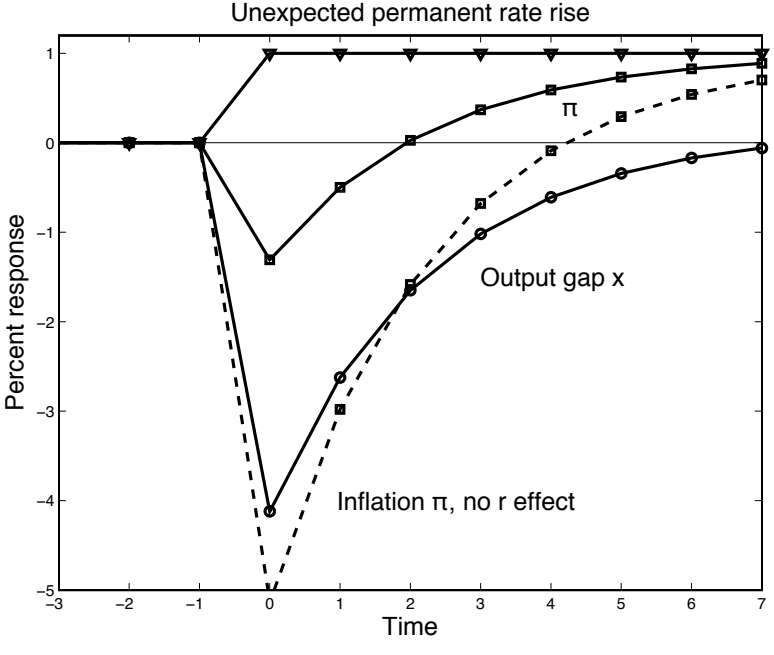

FIGURE 3.1.3. Response to permanent interest rate rises with long-term debt. I use the 2014 maturity structure of the debt. The dotted line ignores the effect of rising real rates in devaluing future surpluses.

using the same economic model as in Figure 3.1.2, but with long-term debt calibrated to the US maturity structure. The main "inflation" line shows the temporary decline and later rise. The output gap line shows that this temporary tightening still produces a substantial recession.

This theory works even in a completely frictionless model—no price stickiness, no money, no frictions at all. It allows the analysis of monetary policy to (finally) start with simple supply and demand, like the rest of economics, and then add frictions to better match the economic dynamics in the data, rather than requiring monetary, financial, pricing, or other frictions just to get the basic determination of the price level and basic signs and stability properties of monetary policy right. And it describes interest rate policy, quantitative easing, and forward guidance in one breath. The interest rate rise involves bond sales that look just like quantitative easing. Forward guidance of future interest rate declines lowers bond prices; in fact, the expectation of future high interest rates is the key mechanism.

However, this mechanism does not restore classic beliefs. First, it only works for unexpected interest rate increases. If people know the interest rate increase will happen, they are not surprised by lower bond prices, and the inflation happens immediately without a temporary dip. Second, in part for this reason, it does not rescue policy advice that relies on expected interest rates lowering inflation. Central banks cannot plan to systematically raise and lower interest rates in response, say, to inflation by this mechanism. Third, the mechanism works entirely via fiscal policy. If this is "monetary policy," it has nothing at all to do with money, credit, lending, price stickiness, or anything else. In turn, whether it works or not depends entirely on the Treasury. When the Fed raises rates, and thus future inflation, the Treasury could say, "Great, now we don't have to raise taxes as much to pay off the debt. The Fed is inflating it away for us." If it does so, the inflation dip disappears.

We are left with a logical conundrum: either (1) the world really is Fisherian, and higher interest rates raise inflation in both the short and long run; (2) more complex ingredients, including frictions or irrationalities, are *necessary* as well as sufficient to deliver the negative sign, so this hallowed belief relies on those complex ingredients; or (3) the negative sign ultimately relies on the fiscal theory story involving long-term debt—and has nothing to do with any of the mechanisms commonly blamed for it.

The first view is not as crazy as it seems. The empirical evidence for the traditional sign is weak. Estimates for years confronted the "price puzzle" of the data indicating that higher interest rates led to higher inflation. This finding was only tempered with lots and lots of effort. Perhaps the price puzzle has been trying to tell us something for all these decades.

OCCAM'S RAZOR

Proof is rare in economics, and one can imagine many patches to rescue existing theories. Perhaps inflation really is unstable at the zero bound, but clever central bankers around the world offset a pending deflationary spiral with just enough hyperinflationary quantitative easing, helped by fiscal stimulus, that all we see is quiet. Even in Japan. Perhaps. Or perhaps the stability we observe is just what it seems—stability. Occam's razor—accept the simplest explanation—suggests the latter.

Similarly, one might rescue the long-standing prediction that interest rates at the zero bound would result in additional sunspot volatility by supposing that sunspots just didn't happen. But taking that path, one would have to throw out the theory's central empirical success and ask why the literature made such clear and loud predictions. And we're not here for cocktail party ex post explanations; we're here for theories with predictive content. Just why were there no sunspots this time, yet there were lots of them in the 1970s

in this theory's reading? Are our central bankers that much better at making speeches? In any case, choosing what's on the menu, this possibility remains in the realm of future possibilities, as no New Keynesian research has offered a serious explanation. And again, Occam's razor speaks loudly. Perhaps there are no sunspots now *or* in the 1970s. Perhaps the whole sunspot theory is wrong. Perhaps the very simple fiscal theory that has no sunspots at any time describes now and the 1970s.

Perhaps the long zero bound represents the proverbial seven years of bad luck—twenty-five in Japan—and not a true zero bound. Perhaps people, like many professional forecasters, expected a swift recovery and interest rates rising above zero within a year, allowing conventional "active" (moving quickly with inflation) interest rate policy to emerge. Perhaps this wasn't really a period of passive monetary policy (interest rates not moving enough with inflation) like the 1970s. That would explain the absence of sunspots.

This story is also offered for the 1980s. The 1980s pose a similar challenge to New Keynesian models, because they predict that persistent interest rate increases eventually raise inflation. The Fed can only generate a decline in inflation from a quite temporary increase in interest rates. But the conventional view of the 1980s is that persistent, indeed dogged, high interest rates were required to squeeze out inflation. Well, maybe the 1980–2000 experience was twenty years of good luck. Maybe people continually expected inflation to return and were surprised that it did not. I call these the "springtime in Chicago" expectations, as it seems every week the weather forecast reads, "Snow and ice this week, returning to the seventies next week."

Well, perhaps. We should not be religious about rational expectations. Perhaps the 1980s and 2008 were unique events, and people had no way of preparing for them or knowing what would happen. Perhaps the time series we observe are a fundamentally misleading

measure of the structural response functions, the former stable but the latter really unstable.

Or perhaps not. At some point, after many decades, perhaps we should take the very simple model sitting on the plate before us, which describes these episodes with simple supply and demand economics, without requiring people to be fundamentally wrong in how they perceive the world and to ignore the ample historical precedents of financial crises, inflations, deflations, and near-zero interest rates. Perhaps every day is not a new stochastic process, but just a day like the last.

Furthermore, a stable quiet zero bound does not require extreme rational expectations. Small amounts of forward-looking behavior will do. The stable quiet zero bound still obtains if one of the consumption or pricing decisions is irrationally backward looking. To rescue classic beliefs, one needs all expectations to be mechanically adaptive.

To generate the long-standing belief that higher interest rates produce at least temporarily lower inflation, one might naturally start adding complications to the very simple models I outline here, such as extensive borrowing or collateral constraints, hand-to-mouth consumers, a lending channel or other financial frictions, habits, durable goods, housing, multiple goods and other non-separabilities, novel preferences, labor and leisure choices, production, capital, variable capital utilization, adjustment costs, alternative models of price stickiness, informational frictions, market frictions, payments frictions, more complex monetary frictions, timing lags, individual or firm heterogeneity, and so forth. Going farther, perhaps we can add fundamentally different views of expectations formation and equilibrium concepts.

Even this is not so easy. One must face the twin challenges of producing a negative temporary effect of interest rates on inflation, together with the observed long-run stability of inflation at

the zero bound. "Let's just go back to adaptive expectations" will not do. That course produces a negative sign, but it also produces instability and the prediction of a deflation spiral, which we did not see.

One can, and many papers do, add complex ingredients to the New Keynesian framework, which is consistent with stability. If we must go down this path, however, we then accept that there is no simple economic model that produces the hallowed belief that higher interest rates reduce inflation. The extra complexities become *necessary* rather than just *sufficient*. Imagine a Fed chair trying to explain to Congress that monetary policy *necessarily* relies on such ingredients for the basic sign of its effect. In the absence of the Fed's technocratic understanding of such ingredients, the Fed would steer the ship the other way, raising interest rates to raise inflation, not the other way around.

If so, that circumstance radically changes the nature of monetary policy. And one must admit that the scientific basis on which we analyze policy and offer advice to public officials and the public at large becomes more tenuous.

I do not mean to disdain frictions, including the above list of ingredients. Such frictions surely are important to understand the details of real-world dynamics. Ideally, we add such frictions to simple models that get the basic sign and stability right. The trouble comes when frictions are necessary to the basic sign and stability.

Again, proof is rare in economics. But ex post patches, in the face of clear predictive failures, are always suspect. Sometimes it is right to patch a theory. Planetary orbits are elliptical, not circular. More often, ex post patches are epicycles, and the Occam's razor advice is right.

That advice is not easy. The theoretical interpretation of the long quiet zero bound I have offered is indeed strikingly simple. But it asserts that long-standing classic doctrines of monetary

economics—that interest-rate pegs must be unstable or that "money" creation must inevitably lead to inflation—were simply wrong. That pill should be hard to swallow.

POLICY

What are the implications of this experience, and its theoretical interpretation, for policy going forward?

First, we should not unduly fear the zero bound. Much current policy discussion regards the past zero bound as a narrow scrape with the deflation spiral and argues for a higher inflation target or dry powder in the arsenal of unconventional monetary policy and large fiscal stimulus to prevent the spiral from breaking out should we return to the zero bound in the next recession or crisis.

Second, we should not unduly fear large interest-paying reserves. We have discovered that abundant, safe, government-provided, interest-paying electronic money will not cause inflation, any more than government-provided banknotes necessarily did in the nineteenth century. (That proposition, regarding the inflationary consequences of paper money, was also hugely contentious.) Much current policy discussion, by contrast, sees large reserves as permanently stimulative, in urgent need of reduction.

Third, we can live with permanently low and steady interest rates, if we wish, so long as people trust fiscal policy. If the real interest rate needs to rise and fall, inflation will eventually fall and rise, respectively, to accommodate that change.

However, the Fed may wish to vary nominal interest rates according to its best guess of needed real interest rates. Such policy can further reduce inflation volatility, and given that prices are somewhat sticky, it will also reduce output volatility. So actual day-to-day policy need not change radically. The Fed will still raise rates when the economy is doing well and lower them when it is doing poorly.

FISCAL FOUNDATIONS

Shoals remain ahead. The fiscal foundations that theory needs to understand the stable quiet zero bound could easily fall apart.

It would be easy to misinterpret these results to say that all a country like Brazil or Turkey, which wishes to lower its inflation rate, needs to do is to lower its interest rate.

First, such an interest rate move must be persistent and credible. You can't just try the waters. Second, it must wait out a potential move in the other direction, via the long-term debt effect, or the many real-world complications discussed above. Most important, the fiscal backing and fiscal coordination must be there, especially for disinflation. Lowering nominal rates cannot cure a fundamentally fiscal inflation.

Successful stabilizations, such as the 1980s in the United States and Europe, involved joint monetary and fiscal reform. Conversely, many countries have seen all sorts of monetary stabilization plans fall apart when fiscal cooperation was lacking. Just lowering interest rates will not work with fiscal trouble brewing.

Likewise, it does not follow from the analysis here that the United States, Europe, and Japan can just peg low interest rates and sleep soundly. The fiscal foundations of our quiet inflation could evaporate quickly as well.

The fiscal theory says that inflation is determined by demand for government bonds, which in turn comes from the expected discounted value of future surpluses. This is an identity—the only question is which one is in investors' minds at the moment. Are investors holding lots of government bonds and not trying to buy goods and services or real assets instead because they think surpluses will be strong or because they are willing to hold government debt at very low rates of return? The answer seems pretty clear: the value of government debt is high now because discount rates—expected real returns on government bonds—are very low right now.

But low discount rates can evaporate quickly, especially when government debt is largely short term and frequently rolled over. A change in discount rate provokes exactly the same sort of unexpected inflation as a change in fiscal surpluses. And like such a change, there is nothing a central bank can do about it.

Concretely, if in the next moment of economic trouble, when our governments try to borrow another several percent of GDP to bail out troubled financial institutions, or fight a war or a recession, or all at the same time, while simultaneously rolling over a large stock of debt, bond market investors may decide our governments are not serious about long-run fiscal solvency. Investors will demand higher real interest rates to hold government debt, putting more strain on budgets. Investors may abandon government debt, driving up inflation. Such an event feels like a "speculative attack," a "bubble," or a "run" to central bankers.

Inflation's resurgence can happen without Phillips curve tightness. It can surprise central bankers of the 2020s just as it did in the 1970s—just as the decline in inflation surprised them in the 1980s, and just as its stability surprised them in the 2010s.

SECTION TWO

Comments on the Zero Lower Bound

Martin Eichenbaum

This essay focuses on two distinct but related points. The first is a critique of John Cochrane's claim that the Great Recession is a Michelson-Morley moment for New Keynesian (NK) models. Since this argument is based on Cochrane (2017), I will reference that paper throughout my comments. The second point builds on