STRATEGIES *for* MONETARY POLICY

EDITED BY
JOHN H. COCHRANE
JOHN B. TAYLOR

CHAPTER ONE

Models, Markets, and Monetary Policy

Richard H. Clarida

The topic of this volume and the Monetary Policy Conference it originates from, Strategies for Monetary Policy, is especially timely. The Federal Reserve System is conducting a review of the strategy, tools, and communication practices we deploy to pursue our dual-mandate goals of maximum employment and price stability. In this review, we expect to benefit from the insights and perspectives that are presented here, as well as those offered at other conferences devoted to this topic, as we assess possible practical ways in which we might refine our existing monetary policy framework to better achieve our dual-mandate goals on a sustained basis.

This essay is not, however, devoted to a broad review of the Fed's monetary policy framework—that process is ongoing, and I would not want to prejudge the outcome—but it will instead focus on some of the important ways in which economic models and financial market signals help me think about conducting monetary policy in practice after a career of thinking about it in theory.

THE ROLE OF MONETARY POLICY

Let me set the scene with a very brief—and certainly selective—review of the evolution over the past several decades of professional

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The views expressed are my own and not necessarily those of other Federal Reserve Board members or Federal Open Market Committee participants. I would like to thank Ed Nelson and Bob Tetlow for their assistance in preparing this speech.

thinking about monetary policy. I will begin with Milton Friedman's landmark 1967 American Economic Association presidential address, "The Role of Monetary Policy."[1] This article is, of course, most famous for its message that there is no long-run, exploitable trade-off between inflation and unemployment. And in this paper, Friedman introduced the concept of the "natural rate of unemployment," which today we call u^*.[2] What is less widely appreciated is that Friedman's article also contains a concise but insightful discussion of Wicksell's "natural rate of interest"—r^* in today's terminology—the real interest rate consistent with price stability. But while u^* and r^* provide key reference points in Friedman's framework for assessing how far an economy may be from its long-run equilibrium in labor and financial markets, they play absolutely no role in the monetary policy rule he advocates: his well-known k-percent rule that central banks should aim for and deliver a constant rate of growth of a monetary aggregate. This simple rule, he believed, could deliver long-run price stability without requiring the central bank to take a stand on, model, or estimate either r^* or u^*. Although he acknowledged that shocks would push u away from u^* (and, implicitly, r away from r^*), Friedman felt the role of monetary policy was to operate with a simple quantity rule that did not itself introduce potential instability into the process by which an economy on its own would converge to u^* and r^*.[3] In Friedman's policy framework, u^* and r^* are economic destinations, not policy rule inputs.

1. See Friedman (1968). Recent retrospectives on Friedman's (1968) American Economic Association address that consider its implications for monetary policy analysis include Hall and Sargent (2018), Laidler (2018), Mankiw and Reis (2018), and Nelson (2018).

2. See Friedman (1968, 8–11). At roughly the same time, Phelps (1967) derived similar results using a formal economic model.

3. Another consideration motivating Friedman's choice of rule was his concern that a more active monetary policy strategy might be difficult to formulate because of the "long and variable lags" in the effect of monetary policy (a term he had coined in Friedman 1948, 254).

Of course, I do not need to elaborate for this audience that the history of *k*-percent rules is that they were rarely tried, and when they were tried in the 1970s and the 1980s, they were found to work much better in theory than in practice.[4] Velocity relationships proved to be empirically unstable, and there was often only a very loose connection between the growth rate of the monetary base—which the central bank could control—and the growth rate of the broader monetary aggregates, which are more tightly linked to economic activity. Moreover, the macroeconomic priority in the 1980s in the United States, the United Kingdom, and other major countries was to do "whatever it takes" to break the back of inflation and to restore the credibility squandered by central banks that had been unable or unwilling to provide a nominal anchor after the collapse of the Bretton Woods system.

By the early 1990s, the back of inflation had been broken (thank you, Paul Volcker), conditions for price stability had been achieved (thank you, Alan Greenspan), and the time was right for something to fill the vacuum in central bank practice left by the realization that monetary aggregate targeting was not, in practice, a workable monetary policy framework. Although it was mostly unspoken, there was a growing sense at the time that a simple, systematic framework for central bank practice was needed to ensure that the hard-won gains from breaking the back of inflation were not given away by shortsighted, discretionary monetary experiments that were poorly executed, such as had been the case in the 1970s.

4. See Clarida, Galí, and Gertler (1999, Result 10, 1687). Monetary targeting was adopted to a limited degree by the Federal Reserve and other central banks in the 1970s and 1980s, but it did not endure. Even during the period from 1979 to 1982, when the Federal Open Market Committee was most focused on monetary aggregates, policy makers were still concerned with interest rates in the setting of policy, and ultimate objectives for the output gap and inflation figured as criteria for policy decisions. See, for example, Taylor (1995, 1999), Clarida (1999), and Clarida, Galí, and Gertler (2000). In addition, Poole (1970) and Woodford (2003) are key references on the theoretical criticisms of monetary targeting.

POLICY RATE RULES

That vacuum, of course, was filled by John Taylor in his classic 1993 paper, "Discretion vs. Policy Rules in Practice." The average reader of this book need not be reminded of the enormous impact this single paper had not only on the field of monetary economics but also—and more important—on the practice of monetary policy. For our purposes today, I will note that the crucial insight of John's paper was that whereas a central bank could pick the "k" in a "k-percent" rule on its own, without any reference to the underlying parameters of the economy (including r^* and u^*), a well-designed rule for setting a short-term interest rate as a policy instrument should, John argued, respect several requirements.[5] First, the rule should anchor the nominal policy rate at a level equal to the sum of its estimate of the neutral real interest rate (r^*) and the inflation target. Second, to achieve this nominal anchor, the central bank should be prepared to raise the nominal policy rate by more than one-for-one when inflation exceeds target (the Taylor principle). And, third, the central bank should lean against the wind when output—or, via an Okun's law relationship, the unemployment rate—deviates from its estimate of potential (u^*).

In other words, whereas in Friedman's k-percent policy rule u^* and r^* are destinations irrelevant to the choice of k, in the Taylor rule—and most subsequent Taylor-type rules—u^* and r^* are necessary inputs. As Woodford (2003) demonstrates theoretically, the first two requirements for a Taylor-type rule are necessary for it to be consistent with the objective of price stability. The

5. On the specification and properties of the Taylor rule, see especially Taylor (1993, 1999), as well as Clarida, Galí, and Gertler (1999, 2000) and Woodford (2003). Another key study of simple interest rate rules was Henderson and McKibbin (1993). It should be noted that a Taylor-type rule is an *instrument* rule for achieving the inflation objective that enters the rule. In practice, it is one way to implement a flexible inflation targeting regime. See Bernanke et al. (1999) and Svensson (1997, 1999) for important contributions on the considerations involved in specifying an inflation-targeting monetary policy strategy.

third requirement—that monetary policy lean against the wind in response to an output or unemployment gap—not only contributes to the objective of price stability, but also is obviously desirable from the perspective of a central bank like the Fed that has a dual mandate.

The Taylor approach to instrument-rule specification has been found to produce good macroeconomic outcomes across a wide range of macroeconomic models. Moreover, in a broad class of both closed and open economy dynamic stochastic general equilibrium, or DSGE, models, Taylor-type rules can be shown to be optimal given the underlying micro foundations of these models.

In original formulations of Taylor-type rules, r^* was treated as constant and set equal to 2 percent, and potential output was set equal to the Congressional Budget Office (CBO) estimates of potential output, or, in specifications using the unemployment rate as the activity variable, u^* was set equal to the CBO's estimate of the natural unemployment rate. These assumptions were reasonable at the time, and in the years before the global financial crisis I myself wrote a number of papers with coauthors that incorporated them.[6]

A DIVE INTO DATA DEPENDENCE

Fast-forward to today. At each Federal Open Market Committee (FOMC) meeting, my colleagues and I consult potential policy rate paths implied by a number of policy rules, as we assess what adjustments, if any, may be required for the stance of monetary policy to achieve and maintain our dual-mandate objectives.[7] A presentation and discussion of several of these rules has been

6. See, for example, Clarida, Galí, and Gertler (1999, 2000).

7. For the FOMC's description of its mandate, see the FOMC's (2019) "Statement on Longer-Run Goals and Monetary Policy Strategy." The FOMC first adopted this statement in January 2012 and has reaffirmed the statement at the start of each subsequent year (including in 2019, when all seventeen FOMC participants supported it).

included in the semiannual *Monetary Policy Report* to Congress since July 2017.[8] One thing I have come to appreciate is that as I assess the benefits and costs of alternative policy scenarios based on a set of policy rules and economic projections, it is important to recognize up front that key inputs to this assessment, including u^* and r^*, are unobservable and must be inferred from data via models.[9] I would now like to discuss how I incorporate such considerations into thinking about how to choose among monetary policy alternatives.

A monetary policy strategy must find a way to combine incoming data and a model of the economy with a healthy dose of judgment—and humility!—to formulate, and then communicate, a path for the policy rate most consistent with the central bank's objectives. There are two distinct ways in which I think that the path for the federal funds rate should be data dependent.[10] Monetary policy should be data dependent in the sense that incoming data reveal at any point in time where the economy is relative to the ultimate objectives of price stability and maximum employment. This information on where the economy is relative to the goals of monetary policy is an important input into interest rate feedback rules—after all, they have to feed back on something. Data dependence in this sense is well understood, as it is of the type implied by a large family of policy rules, including Taylor-type

8. The box "Monetary Policy Rules and Systematic Monetary Policy" in the Board of Governors' February 2019 *Monetary Policy Report* (MPR) describes how simple policy rules are used in theory and in practical policy making. See Board of Governors (2019). The box "Complexities of Monetary Policy Rules" in the July 2018 MPR discusses how shifts in r^* complicate monetary policy decision making. See Board of Governors (2018). A note, titled "Policy Rules and How Policymakers Use Them," on the board's website covers similar ground and is available at https://www.federalreserve.gov/monetarypolicy/policy-rules-and-how-policymakers-use-them.htm.

9. As Friedman once put it, "I don't know what the natural rate is, neither do you, and neither does anyone else" (quoted in Bennett 1995).

10. See Clarida (2018a, 2018b).

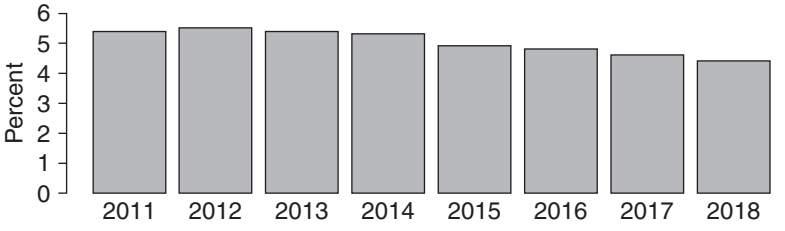

FIGURE 1.1. Assessments of the Longer-Run Normal Unemployment Rate from the Summary of Economic Projections

Source: Federal Reserve Board, Summary of Economic Projections for 2011 to 2013 (https://www.federalreserve.gov/monetarypolicy/fomc_historical.htm) and for 2014 to 2018 (https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm).

Note: Calculated from the final Summary of Economic Projections in each calendar year (November for 2011; December for other years). The value shown is the median of the individual Federal Open Market Committee participant projections for the fourth quarter of each calendar year. (For 2014, the value is the midpoint of the central tendency, as the median is not publicly available.)

rules discussed earlier, in which the parameters of the economy needed to formulate such rules are taken as known.

But, of course, key parameters needed to formulate such rules, including u^* and r^*, are unknown. As a result, in the real world, monetary policy should be—and in the United States, I believe, is—data dependent in a second sense: policy makers should and do study incoming data and use models to extract signals that enable them to update and improve estimates of r^* and u^*. As indicated in the Summary of Economic Projections, FOMC participants have, over the past seven years, repeatedly revised down their estimates of both u^* and r^* as unemployment fell and real interest rates remained well below prior estimates of neutral without the rise in inflation those earlier estimates would have predicted (figures 1.1 and 1.2). And these revisions to u^* and r^* appeared to have had an important influence on the path for the policy rate actually implemented in recent years. One could interpret any changes in the conduct of policy as a shift in the central bank's reaction function. But in my view, when such changes result from revised estimates of u^* or r^*, they merely reflect an updating of an existing reaction function.

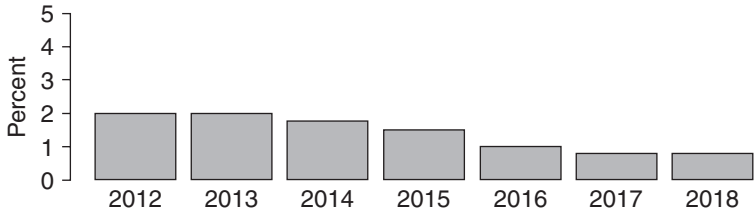

FIGURE 1.2. Assessments of the Longer-Run Inflation-Adjusted Federal Funds Rate from the Summary of Economic Projections

Source: See the source note of figure 1.

Note: The value shown consists of the median of individual Federal Open Market Committee (FOMC) participant assessments of the longer-run nominal federal funds rate or midpoint of the target range, as given in the December Summary of Economic Projections for the indicated year, minus the FOMC's inflation objective of 2 percent. (For each of the years shown, FOMC participants' projections for the longer-run inflation rate also equaled 2 percent.)

In addition to u^* and r^*, another important input into any monetary policy assessment is the state of inflation expectations. Since the late 1990s, inflation expectations appear to have been stable and are often said to be "well anchored." However, inflation expectations are not directly observable; they must be inferred from models, other macroeconomic information, market prices, and surveys. Longer-term inflation expectations that are anchored materially above or below the 2 percent inflation objective present a risk to price stability.

For this reason, policy makers should and do study incoming data to extract signals that can be used to update and improve estimates of expected inflation. In many theoretical rational expectations models, expected inflation is anchored at the target level by assumption. From a risk-management perspective, it makes sense, I believe, to regularly test this assumption against empirical evidence.

FINANCIAL MARKETS AND MONETARY POLICY—EXTRACTING SIGNAL FROM NOISE

Because the true model of the economy is unknown, either because the structure is unknown or because the parameters of a known

structure are evolving, I believe policy makers should consult a number and variety of sources of information about neutral real interest rates and expected inflation, to name just two key macroeconomic variables. Because macroeconomic models of r^* and long-term inflation expectations are potentially misspecified, seeking out other sources of information that are not derived from the same models can be especially useful. To be sure, financial market signals are inevitably noisy, and day-to-day movements in asset prices are unlikely to tell us much about the cyclical or structural position of the economy.[11] However, persistent shifts in financial market conditions can be informative, and signals derived from financial market data—along with surveys of households, firms, and market participants, data, as well as outside forecasts—can be an important complement to estimates obtained from historically estimated and calibrated macroeconomic models.[12]

Interest rate futures and interest rate swaps markets provide one source of high-frequency information about the path and destination for the federal funds rate expected by market participants (figure 1.3). Interest rate option markets, under certain assumptions,

11. Uncertainty regarding r^*, u^*, and long-term inflation expectations is not the only source of uncertainty that has implications for monetary policy. Edge, Laubach, and Williams (2005) show how the duration of a productivity shock can affect even the direction of the best monetary policy response. Erceg et al. (2018) find that even in conditions of substantial output gap uncertainty and uncertainty about the slope of the Phillips curve, a notable response to the estimated output gap in a Taylor-type rule is generally beneficial. And Eusepi and Preston (2018) show that replacing model-consistent expectations with forms of adaptive learning means that some, but not all, of the key results regarding best conduct in monetary policy under full information carry through.

12. Like many others, I believe that monetary policy should respond to financial market fluctuations when they have material implications for our outlook for employment and inflation, but monetary policy should not generally target asset prices themselves.

The Federal Reserve uses survey data and conducts surveys of its own on a range of macroeconomic and financial conditions. Among the surveys the Fed conducts are the Senior Loan Officer Opinion Survey on Bank Lending Practices and the Senior Credit Officer Opinion Survey on Dealer Financing Terms. In addition, the staff at the Federal Reserve Board uses disaggregated and high-frequency data to estimate the state of the economy in real time. Such data include disaggregated labor market data from ADP and data on expenditures from credit card transactions.

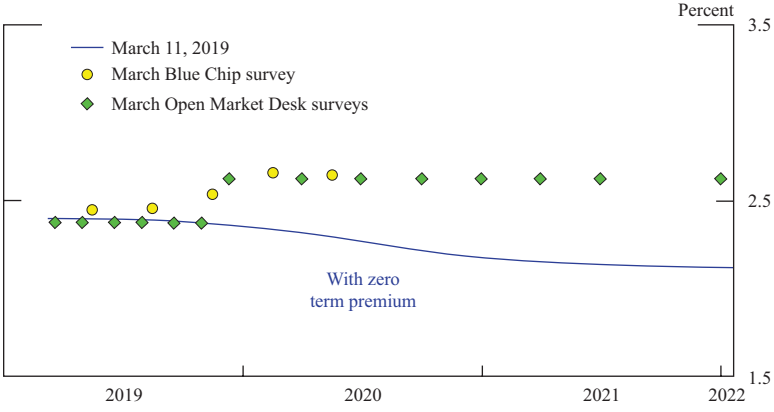

FIGURE 1.3. Projections of the Federal Funds Rate Path Implied by Surveys and Market Quotes

Source: Bloomberg Finance LP; Federal Reserve Board staff estimates; Wolters Kluwer, Blue Chip Financial Forecasts; Federal Reserve Bank of New York, Survey of Primary Dealers and Survey of Market Participants.

Note: The path with zero term premium is estimated using overnight index swap quotes with a spline approach and a term premium of 0 basis points.

can offer insights about the entire ex ante probability distribution of policy rate outcomes for calendar dates near or far into the future (figure 1.4). And, indeed, when one reads that a future policy decision by the Fed or any central bank is "fully priced in," this is usually based on a "straight read" of futures and options prices. But these signals from interest rate derivatives markets are only a pure measure of the expected policy rate path under the assumption of a zero risk premium. For this reason, it is useful to compare policy rate paths derived from market prices with the path obtained from surveys of market participants, which, while subject to measurement error, should not be contaminated with a term premium. Market- and survey-based estimates of the policy rate path are often highly correlated. But when there is a divergence between the path or destination for the policy rate implied by the surveys and a straight read of interest rate derivatives prices, I place at least as much weight on the survey evidence (e.g., derived from

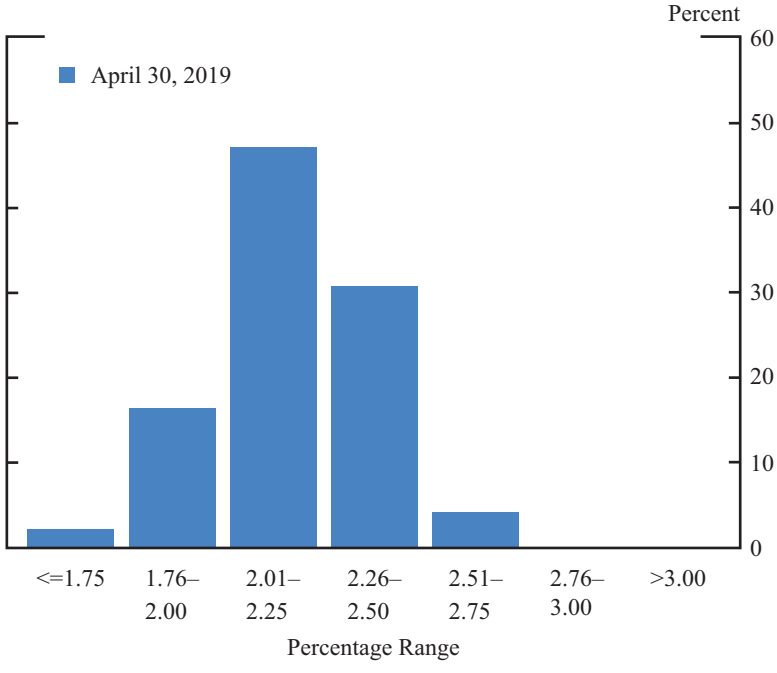

FIGURE 1.4. Market-Implied Probability Distribution of the Federal Funds Rate for Year-End 2019

Source: CME Group; Federal Reserve staff estimates.

Note: Estimated from federal funds futures options (not adjusted for risk premiums). Probabilities are zero for values above 2.75 percent.

the surveys of primary dealers and market participants conducted by the Federal Reserve Bank of New York) as I do on the estimates obtained from market prices (figure 1.3).

The Treasury yield curve can provide another source of information about the expected path and ultimate longer-run destination of the policy rate. But, again, the yield curve, like the interest rate futures strip, reflects not only expectations of the path of short-term interest rates but also liquidity and term premium factors. Thus, to extract signal about policy from noise in the yield curve, a term structure model is required. But different term structure models can and do

produce different estimates of the expected path for policy and thus the term premium. Moreover, fluctuations in the term premium on US Treasury yields are driven in part by a significant "global" factor, which complicates efforts to treat the slope of the yield curve as a sufficient statistic for the expected path of US monetary policy (Clarida 2018c). Again, here, surveys of market participants can provide useful information—for example, about "the expected average federal funds rate over the next 10 years," which provides an alternative way to identify the term premium component in the US Treasury curve.

Quotes from the Treasury Inflation-Protected Securities (TIPS) market can provide valuable information about two key inputs to monetary policy analysis: long-run r^* and expected inflation.[13] Direct reads of TIPS spot rates and forward rates are signals of the levels of real interest rates that investors expect at various horizons, and they can be used to complement model-based estimates of r^*. In addition, TIPS market data, together with nominal Treasury yields, can be used to construct measures of "breakeven inflation" or inflation compensation that provide a noisy signal of market expectations of future inflation. But, again, a straight read of breakeven inflation needs to be augmented with a model to filter out the liquidity and risk premium components that place a wedge between inflation compensation and expected inflation.

As is the case with the yield curve and interest rate futures, it is useful to compare estimates of expected inflation derived from breakeven inflation data with estimates of expected inflation obtained from surveys—for example, the expected inflation over

13. Well before the launch of the TIPS market, Friedman (1984) stressed the benefits to monetary policy analysis that would arise from the availability of market-based estimates of longer-term inflation expectations, and he contrasted that situation with the one then prevailing, in which it was difficult to ascertain the real yields implied by the market's longer-term nominal yields. In a similar vein, Campbell and Clarida (1987, 105) observed—also in the pre-TIPS era—that "it is hard to measure expected long-term inflation rates."

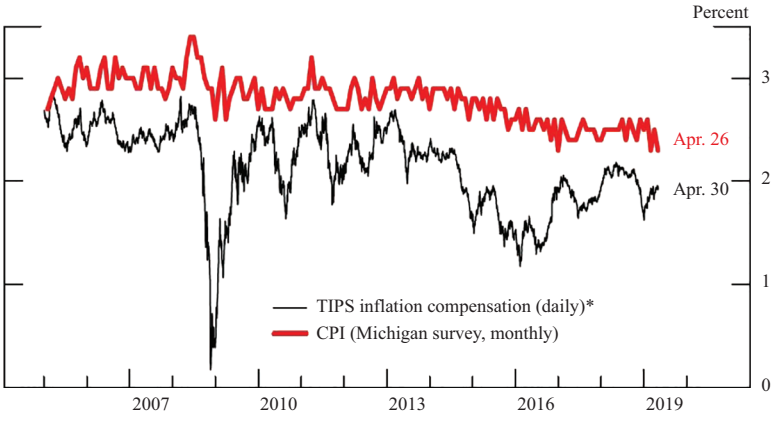

FIGURE 1.5. Market- and Survey-Based Measures of Longer-Run Inflation Expectations

Note: Estimates based on smoothed nominal and inflation-indexed Treasury yield curves. Michigan survey expectations represent median responses. TIPS is Treasury Inflation-Protected Securities; CPI is consumer price index.

*Adjusted for lagged indexation of Treasury Inflation-Protected Securities (the carry effect).

Source: Federal Reserve Bank of New York; Federal Reserve Board staff calculations; Bloomberg Finance LP; University of Michigan, Surveys of Consumers, http://new.sca.isr.umich.edu.

the next five to ten years from the University of Michigan Surveys of Consumers (figure 1.5). Market- and survey-based estimates of expected inflation are correlated, but, again, when there is a divergence between the two, I place at least as much weight on the survey evidence as on the market-derived estimates.

The examples I have mentioned illustrate the important point that, in practice, there is not typically a clean distinction between "model-based" and "market-based" inference of key economic variables such as r^* and expected inflation. The reason is that market prices reflect not only market expectations but also risk and liquidity premiums that need to be filtered out to recover the object of interest—for example, expected inflation or long-run r^*. This filtering almost always requires a model of some sort, so even market-based estimates of key inputs to monetary policy are, to some extent, model dependent.

IMPLICATIONS FOR MONETARY POLICY

Let me now draw together some implications of the approach to models, markets, and monetary policy I have laid out in these remarks. Macroeconomic models are, of course, an essential tool for monetary policy analysis, but the structure of the economy evolves, and the policy framework must be—and I believe, at the Federal Reserve, is—nimble enough to respect this evolution. Although financial market signals can and sometimes do provide a reality check on the predictions of "a model gone astray," market prices are, at best, noisy signals of the macroeconomic variables of interest, and the process of filtering out the noise itself requires a model—and good judgment. Survey estimates of the long-run destination for key monetary policy inputs can—and, at the Fed, do—complement the predictions from macro models and market prices (figure 1.6).[14] Yes, the Fed's job would be (much) easier if the real world of 2019 satisfied the requirements to run Friedman's *k*-percent policy rule, but it does not and has not for at least fifty years, and our policy framework must and does reflect this reality.

This reality includes the fact that the US economy is in a very good place. The unemployment rate is at a fifty-year low, real wages are rising in line with productivity, inflationary pressures are muted, and expected inflation is stable. Moreover, the federal funds rate is now in the range of estimates of its longer-run neutral level, and the unemployment rate is not far below many estimates of u^*. Plugging these estimates into a 1993 Taylor rule produces a federal funds rate very close to our current target range for the policy rate.[15]

14. It is important to note that the range of model estimates that is shown in the shaded portion of figure 1.6 is not a confidence interval. If parameter uncertainty in the estimates was allowed for, the range would be wider still. Yield curve data can also be used to compute estimates of the neutral rate of interest, as in Bauer and Rudebusch (2019).

15. Figure 1.7 summarizes the overall pattern displayed over time of various model-based estimates of r^*. Recent r^* estimates from the models considered, as well as their confidence intervals, are shown in figure 1.8. The sources for both figures are given at the bottom of figure 1.8.

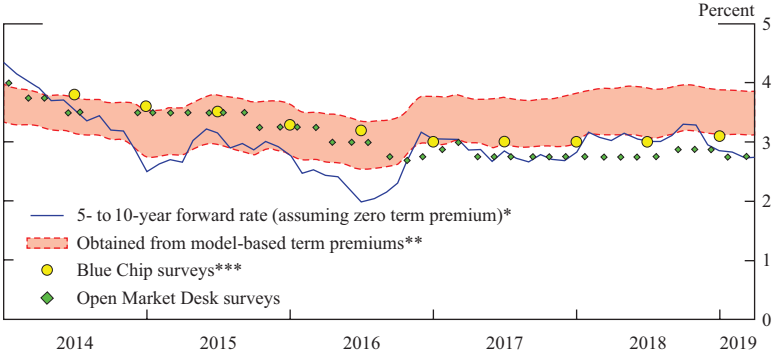

FIGURE 1.6. Measures of Longer-Run Federal Funds Rate Expectations

Source: Wolters Kluwer, Blue Chip Financial Forecasts; Federal Reserve Bank of New York, Survey of Primary Dealers and Survey of Market Participants; Federal Reserve Board staff estimates.

*Monthly average 5- to 10-year forward rate derived from prices of Treasury securities.

**Monthly average 5- to 10-year forward rate adjusted for three alternative model-based term premium estimates using Kim and Wright (2005), D'Amico, Kim, and Wei (2018), and Priebsch (2017).

***Most recent longer-run value is from the December 2018 Blue Chip survey.

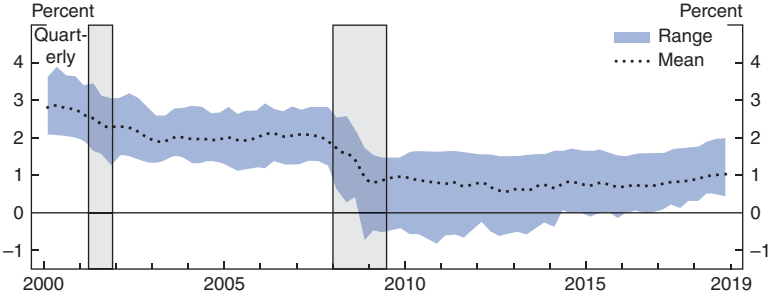

FIGURE 1.7. Historical Evolution of r^*: Estimates from Selected Time-Series Models

Source: Federal Reserve Board staff estimates of the r^* models in figure 8 below.

Note: The shaded bars indicate periods of business recession as defined by the National Bureau of Economic Research.

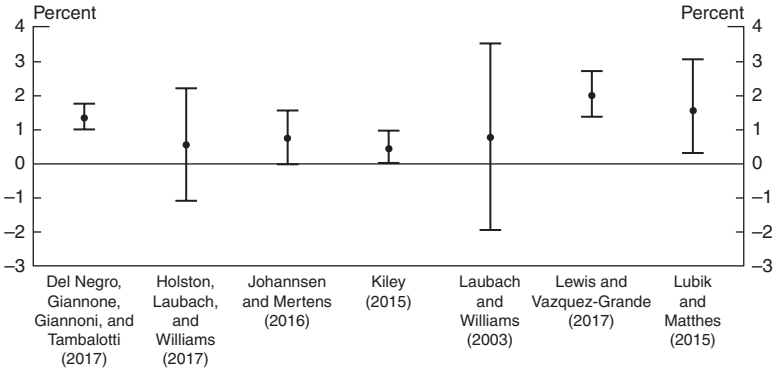

FIGURE 1.8. Uncertainty Bands around Recent Point Estimates of r^* (Selected Models)

Note: The circle gives the r^* estimate for the first quarter of 2019 from each model, while the bars indicate the 95 percent confidence interval for the estimate.

Source: Federal Reserve Board staff calculations, using the models indicated on the x-axis.

So with the economy operating at or very close to the Fed's dual-mandate objectives and with the policy rate in the range of FOMC participants' estimates of neutral, we can, I believe, afford to be data dependent—in both senses of the term as I have discussed—as we assess what, if any, further adjustments in our policy stance might be required to maintain our dual-mandate objectives of maximum employment and price stability.

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GENERAL DISCUSSION

MICHAEL BORDO: My question is about the concept of data dependence. It seems pretty close to what Ben Bernanke and Rick Mishkin called "constrained discretion" a few years ago. So the question is, where do you draw the line between the constrained part, which could be what you call rule-like behavior, and discretion, which could be looking at everything, that is, fine-tuning. So the real question is how do you make that distinction?

RICHARD CLARIDA: It's a great point, and I agree it would be easier if u^* and r^* didn't move around. And so I agree with you. There needs to be a discipline there. And I think the ultimate discipline on the Fed or any central bank is whether or not we do achieve and maintain our objectives, so if the central bank consistently gets $r^*$and u^* wrong, and inflation moves up, as it did in the seventies, then discretion is not serving well. But I do believe that what focuses the Fed and other successful central banks is that they're being evaluated on achieving their objectives. And of course, not only actual but also expected inflation is a key element of this. So I think that in reality that is the check that we need to respect and we do respect.

JOHN TAYLOR: One of the things that I found very interesting about your remarks it that there's not only a strategy or rule, there's a way to determine the u^*or r^*. And I think sometimes one gets concerned that so much focus on $u^*$and r^* tends to dominate, and the fluctuations in those are bigger than any kind of rule. And I think you're trying to prevent that, but can you comment on that?

CLARIDA: You're right. And I think that was why I wanted to devote my remarks today to that, because I think the central issue that faces the Fed and other central banks is that it would be irresponsible to ignore the evolution of the economy. But also, you

certainly need a check and a discipline and an approach to doing that, which is why I suggested in my talk, speaking for myself, I don't want to put all my eggs in the basket of either a theoretical model or market prices, so I'm constantly checking back and forth. And so, I think you need both. And as I mentioned in response to Mike's question, the ultimate discipline is the outcomes achieved, both in terms of inflation and in the case of the Fed as the dual mandate. And here, inflation expectations are also key.

So, John, when you and I began our careers in the seventies and eighties, if we'd had data on TIPS, I'm sure in the seventies they would have shown expected inflation was not 2, it was 14. I would have hoped that you and I would have paid attention to that then. So I think that's where the market pricing comes in as well.

CHRIS CROWE: You said that you saw the economy in a good place right now, and it's hard to disagree with that in the short term. But if you look historically, it's quite typical when the unemployment rate is this low that within a year or two the economy is in not such a good place, heading toward recession. Do you see any risks in that direction right now, and if not, what's different this time around?

CLARIDA: Obviously, policy needs to be forward looking. So, the decisions that a central bank makes today need to depend on the view that it has on the evolution of the economy, long and variable lags, as [Milton] Friedman taught us. And of course, at the Federal Reserve, we are very focused on looking at a wide range of indicators about trends in labor markets, in goods markets, and in financial market–based estimates of surveys. So, we do not see that evidence now. But in any economy that's evolving in a stochastic fashion, there are going to be upside and downside risks on that path. And central banks need to be vigilant and alert to both sides of those risks.

CHARLES PLOSSER: Thank you, Rich, for a great talk. I enjoyed it very much. I want to follow up on Mike Bordo's question just a little bit. I believe you're right, the ultimate test is, does the Fed meet its mandated goals. That's one of the things that Milton would have argued, I would think, with his *k*-percent rule, but it's more than just meeting the goals. It's about the instability and uncertainty created in the economy. So you didn't mention that part of it. And so, you can say, you might ask the question, well, is the Fed meeting its goal? But at the same time, there's a question of volatility or instability or uncertainty that can be created in the policy reaction function, or the discretion that's being exercised. So how do you balance that, because that's kind of like the counterfactual that, are you introducing more instability than might be necessary by the discretionary part of your view?

CLARIDA: And I understand that, and indeed, I did make reference in my prepared remarks to Friedman's case for the *k*-percent rule, that it was sort of the Hippocratic Oath to do no harm. And I certainly think my colleagues keep that in mind as well, but again with the discipline that we have to deal and implement policy in the world as we find it, not as in the world that Friedman assumed. That being said, certainly, none of us wants to nor do we believe that we're a source of instability. But clearly, that's an important discipline that we need to respect.

KRISHNA GUHA: Thank you. So, Rich, in your discussion you talked about the importance of filtering for risk premia and so on when we're extracting signals about expectations in financial markets. But I wanted to ask you about risk premia themselves. So, if we were to observe, which I think we have observed, that persistent negative term premia, specifically persistent negative inflation risk premia, suggests that financial market participants see a need to ensure against the low-inflation state, what would the implications for that be for policy? Would it suggest the rule or framework needs to be reconsidered? Or

can you imagine that you were conducting policy appropriately, and the equilibrium condition was still a sizable negative inflation risk premium?

CLARIDA: I think there are several pieces to that Krishna. First, yes, we—and you—do consult those indicators of those tail risks. But as you can appreciate, those are all model specific, because, to get a little wonkish here, you have to specify the stochastic discount factor or risk-neutral pricing. So, yes. We are alert to that.

I think more generally, though, the way I think the essence of your question that's relevant for the Fed and other central banks is, because we're operating in a world of low riskless rates, a low r^* world, and it is a global phenomenon, and that's a factor that impinges on the United States, the fact that you have very, very low riskless rates in many other advanced countries, clearly a global capital market's going to have an influence here. And so, I do think that central banks need to be alert—that closer to the zero bound for any given probability of shocks, you're more likely to hit it. And that does need to factor into the way that we think about the evolution of policy, but I don't think in a mechanical way, as I'm sure you weren't suggesting.

SEBASTIAN EDWARDS: I want to follow up on what you just said right now. So those of us who follow the market and the macro picture will listen very carefully to what the chairman says, to what you say, to what your colleagues say. But we also listen to Mario Draghi and Mark Carney, and we look at the international picture. And until your answer to the previous question, you had sort of ignored that. And I know that you have done a lot of work on the subject. Is there information out there in the currency markets or in other nations? John Taylor mentioned your paper from a few years back, "Optimal Monetary Policy in Closed Versus Open Economies," but your talk from my perspective was very US centered, which is right for the vice chairman. But what about the signals that come from the open economy?

CLARIDA: A little self-promotion. So I gave a speech at the Banque de France conference about a month ago called "Global Considerations for US Monetary Policy." So I will send you that. There's an entire speech on that. And I did mention in my remarks, and certainly my professional career was devoted to this, there are a lot of US asset prices that have a substantial global component as predicted by both economic theory and empirical evidence. And so certainly, when I start talking about market prices, especially for bond yields, there's a very substantial global component that one needs to sort out. And it's just simply not the case that either the slope or the level of the US yield curve by itself is a sufficient statistic for the outlook for the United States. But that was another speech.

BRIAN SACK: So, long-term inflation expectations obviously are playing a key role in all of this framework discussion. And you can imagine that if you had a good measure of them, they would play a huge role in terms of measuring the accountability of the central bank and even as a variable that can enter into your reaction function. Now, as you noted, we don't have good measures of them. It's very complicated to extract signals from markets, to interpret surveys correctly, and to account for the whole set of information. But I wanted to ask, do you think we can do better than just saying, "Well, we don't measure them very well?" I mean, would there be an advantage to the Fed actually stating what its best reading is at any point in time of where long-term inflation expectations are, taking into account all these signals? Maybe that would deliver some accountability and a chance to actually be systematic in terms of how policy responds to them?

CLARIDA: I think it's an excellent point. What I would say, and I think Bob Rubin and Larry Summers deserve a lot of credit for actually introducing the TIPS market, because for all of its flaws and all of its problems, I think we're much better off as policy makers looking at those noisy signals than having zero signal.

So, my own sense is there's no unique signal of inflation expectations as there is for an absolute price index. So the reality is, you're going to always be comparing signals from different sources, you know? And whether or not one can come up with an ideal or index of weighting those is certainly something I haven't thought about but certainly something worth thinking about.

JOHN COCHRANE: Well, but you're willing to go on to ways we've learned beyond what Milton taught. It's not eternal verities. We're all data dependent in a way. And I liked the historical way you started. Which I put as: you know, once we went to the Taylor rule in the 1990s, u^* and r^* were sort of fixed numbers, and we've learned that they move over time. The Fed used to think everything was demand, and now gee, maybe what we can loosely call "supply" moves around. But there still seems to be an assumption that these things move very slowly through time. Whereas in fact, I think today's challenge is maybe u^*, r^*, and potential GDP move much more quickly than we thought. We have with us the father of real business cycle theory, Ed Prescott, in the room, who showed us that in fact a lot of variation can come from supply. And that's the Fed's central problem. Output goes up this quarter—was that demand that we need to offset, or was that supply?—which was just fine. And thinking about it, the Fed doesn't do much modeling of what is the changes of incentives in the tax code. What are the effects of deregulation? To what extent are we seeing high-frequency changes in supply? And it's the elephant in the room. Today's *Wall Street Journal* op-ed took the Fed to task for not thinking enough about whether even shorter-term fluctuations are supply-potential stars rather than signals of demand to be offset. So where do you think that's going? Should we be moving more in that direction, or is the current progress satisfactory?

CLARIDA: Well, I would not like to say to an academic audience that progress is satisfactory, so we can do better. But certainly, John,

in my six or seven months as Fed vice chair, in a number of my public remarks I've tried to emphasize the supply side. And you just have to look at the data. Labor force participation is part of supply. Productivity is part of supply. And it's certainly something that we discuss extensively in our meeting. So I can assure you it's certainly not something that's ignored in the Eccles Building.