Odyssean forward guidance in monetary policy: A primer

Jeffrey R. Campbell

Introduction and summary

The Federal Open Market Committee's (FOMC) monetary policy statement from its September 2013 meeting reads in part:

> In particular, the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored.[1]

This extended reference to the conditions determining the FOMC's future interest rate decisions is an example of *forward guidance*.

Although participants in FOMC meetings have long used speeches and congressional testimony to discuss the Fed's possible responses to economic developments, the Committee has only issued formal and regular forward guidance since February 2000, when it began to include in its statement a "balance of risks." The first one read as follows: "Against the background of its long-run goals of price stability and sustainable economic growth and of the information currently available, the Committee believes the risks are weighted mainly toward conditions that may generate heightened inflation pressures in the foreseeable future."[2] Less than two years later, the Committee's August 21, 2001, statement noted that "... the risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."[3]

Between the FOMC's first statement of risks and the financial crisis that began in August 2007 and intensified in September 2008, the Fed experimented with making its internal decision-making process more transparent and therefore more *forecastable*. In this, they followed several foreign central banks that had already adopted explicit inflation targets. (See Bernanke and Woodford, 2005, for a review of inflation targeting and its implementation outside the United States.) The financial crisis dramatically accelerated the transition to greater openness, and the FOMC's

Jeffrey R. Campbell is a senior economist and research advisor in the Economic Research Department at the Federal Reserve Bank of Chicago and an external fellow at CentER, Tilburg University. *The author is grateful to Marco Bassetto, Charlie Evans, Jonas Fisher, Alejandro Justiniano, and Spencer Krane for many stimulating discussions on forward guidance and to Wouter den Haan, Alejandro Justiniano, and Dick Porter for helpful editorial feedback. This article is being concurrently published in Wouter den Haan (ed.), 2013,* Forward Guidance—Perspectives from Central Bankers, Scholars and Market Participants*, Centre for Economic Policy Research, VoxEU.org.*

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forward guidance became more elaborate and detailed. After lowering the federal funds rate from 5.25 percent in early August 2007 to 0–25 basis points in mid-December 2008, the Committee's statement read: "In particular, the Committee anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time."[4] "Extended period" replaced "some time" in March 2009, adding specificity. This phrase remained in the statement until the August 2011 meeting, when it was replaced with the even more specific "at least through mid-2013." The January 2012 statement pushed this date back to "late 2014."

By this point, these statements had become known as *calendar-based* forward guidance. Campbell et al. (2012) discuss the confusion this language had engendered among the public and market participants as of early 2012. Was "late 2014" a forecast that the economy would remain weak until then or a reassurance that the Committee would keep interest rates low through that date regardless of economic developments? The Committee's September 2012 statement somewhat clarified this by stating that the Committee expects "that a highly accommodative stance of monetary policy will remain appropriate for a considerable time after the economic recovery strengthens."[5] Also, in that statement, "late 2014" became "mid-2015." In its December 12, 2012, statement, the FOMC changed the nature of its forward guidance to reduce confusion by explicitly tying increases in the federal funds rate to unemployment and inflation outcomes, using language nearly identical to that from the September 2013 meeting quoted previously.[6]

It might seem paradoxical that at a time when the FOMC has done so little with its policy interest rate, it has talked so much about its plans. Even in normal times, a policymaker promising particular future actions constrains her future behavior and concomitantly loses flexibility. However, such forward guidance (sometimes called "open-mouth operations") can substantially improve current economic performance when households' and businesses' *current* decisions depend on their expectations of *future* macroeconomic outcomes. If the FOMC's assurances that rates will remain low raise private individuals' expectations for future inflation and growth, then they will wish to consume more today, thereby lifting current aggregate demand and closing the output gap (the gap between actual and potential economic output). Although this benefit might indeed come at the cost of future flexibility, poor enough current macroeconomic performance might merit this sacrifice. When the zero lower bound (ZLB) on interest rates makes further conventional accommodation infeasible, the exchange of future flexibility for current macroeconomic performance becomes especially attractive.

Future policy actions only have impact if credible

In general, statements of future policy intentions have no impact (benign or otherwise) when the public does not find them *credible*. This problem is particularly acute for a central bank, because a central bank seeking to improve households' current and future welfare will be tempted to renege on past interest rate promises. The interest rate that is currently optimal might not be consistent with promises that improved past economic performance, and breaking those promises now does nothing to the past and improves present and future outcomes. If the public anticipates that monetary policymakers will apply such logic in the future, then promises of low future interest rates will not be believed and, therefore, will have no beneficial effect in the present. This conundrum is one example of the *time-consistency problem*, for the discovery of which Kydland and Prescott (1977) received a Nobel Prize in 2004. Since this kind of beneficial forward guidance requires the policymaker to keep past promises, even when sorely tempted to do what seems best at the moment, Campbell et al. (2012) label this *Odyssean forward guidance*. Like Odysseus bound to the mast of his ship, a monetary policymaker must forswear the siren call of the moment and stick to plans laid in the past. Odysseus achieved this with ropes for himself and earwax for his crew. Research into the analogous tools available to monetary policymakers is ongoing.

Of course, not every pronouncement by a monetary policymaker is a promise. Some statements merely forecast the evolution of the private economy. Campbell et al. (2012) label such forecast-based statements *Delphic forward guidance*. Like the pronouncements from the oracle of Delphi, they forecast but do not promise. While Delphic pronouncements undoubtedly contribute positively to the execution of monetary policy, I ignore them in this article to develop instead a primer on the economic theory of Odyssean forward guidance.

This primer's basic framework is the minimal New Keynesian model, in which the central bank chooses the interest rate to achieve the best feasible trade-off of output and inflation. First, I discuss this model, develop key results, and present some simple calculations of optimal monetary policy paths that start with the economy at the zero lower bound. Although I review the model's two linear equations, one inequality, and quadratic social welfare function in the text, I present the main results in figures for simplicity. I conclude the primer with a brief discussion of current monetary policy examined through the lens of this theory.

Forward guidance in the New Keynesian model

Effective forward guidance requires the central bank to *communicate* its intentions and the public to believe that the bank is *committed* to their execution. The potential contribution of communication and commitment to improved monetary policy can be most easily appreciated in the canonical New Keynesian model that summarizes the behavior of producers, households, and a central bank with a Phillips curve, an intertemporal substitution (IS) curve, the zero lower bound on interest rates, and a central bank loss function.

1) $\pi_t = \kappa\tilde{y}_t + \beta\pi_{t+1} + m_t,$

2) $\tilde{y}_t = -\frac{1}{\sigma}\left(i_t - \pi_{t+1} - r_t^n\right) + \tilde{y}_{t+1},$

3) $i_t \geq 0,$

4) $L = \sum_{t=0}^{\infty}\beta^t \frac{1}{2}\left(\pi_t^2 + \lambda\tilde{y}_t^2\right).$

More advanced versions of this model incorporate uncertainty about future macroeconomic outcomes. For the sake of simplicity, this primer abstracts from this complication and presumes that, conditional on the central bank's policy choices, future macroeconomic outcomes can be calculated with certainty.

In equation 1, π_t is the rate of price inflation in year t and $\tilde{y}_t$ is that year's *output gap*, defined to be the percentage deviation of actual output from its potential. (In New Keynesian models, producers can only adjust their dollar-denominated prices infrequently. It is this sluggish price adjustment that drives output away from its potential.) The influence of future inflation on its current level reflects the forward-looking behavior of producers choosing their prices. Woodford (2003) and Galí (2008) present derivations of equation 1 from the optimal pricing decisions of producers who can only adjust their nominal prices infrequently. In those derivations, the coefficient β is the discount factor producers apply to their future profits. The Phillips curve's *slope*, κ, is an increasing function of the frequency of price adjustment. Perfectly flexible prices lead to a vertical Phillips curve, so that $\kappa = \infty$, while perfectly rigid prices set κ to zero. The output gap influences producers' prices because it reflects their current marginal costs of production. The *markup shock* finishes the right-hand side of equation 1. It evolves exogenously and embodies changes in producers' prices that are unrelated to changes in their marginal costs. For example, an exogenous decline in competitive price pressures due to leniency in antitrust enforcement or innovations in market segmentation can show up as a positive m_t. Because the Phillips curve reflects producer decisions, it is often labeled the economy's "supply side."

Equation 2 reflects households' split of current income between saving and consumption. The model's households can invest in a one-year risk-free bond at the nominal interest rate i_t. This choice yields the inflation-adjusted return $i_t - \pi_{t+1}$. Individual households can buy and sell this bond in unlimited amounts, but I keep the model simple by assuming that it is in zero aggregate supply. The economy has no capital or other means for real wealth accumulation, so total consumption must equal total income. Therefore, the output gap $\tilde{y}_t$ also equals the percentage deviation of actual consumption expenditures from their potential. From this perspective, the IS curve relates the current consumption gap to the interest rate and the consumption gap in the next period. The parameter σ is called the *inverse absolute intertemporal elasticity of substitution*. It is typically positive, so that increases in the interest rate induce households to increase saving and delay consumption. On the other hand, high future consumption reduces the incentive to save and increases current consumption. The final term requiring explanation in equation 2 is r_t^n, the *natural rate of interest*. This term is an exogenously evolving sequence that embodies changes in households' relative valuations of current and future consumption. If r_t^n drops but $i_t - \pi_{t+1}$ remains the same, then the household wishes to reduce current expenditures to save more now and, thereby, allow more consumption in the future. In this sense, a relatively low value of r_t^n indicates that the household is unusually patient. However, this household-based interpretation of r_t^n is probably at best a convenient fiction. In practice, many economists interpret low measured levels of r_t^n since the onset of the financial crisis as arising from the crisis itself and the resulting desire of both households and financial firms to remove both debt and risk from their balance sheets.[7] The IS curve can be thought of as the economy's "demand side."

The ZLB in equation 3 seems natural, because negative nominal interest rates are rarely, if ever, observed. It also has empirical appeal, because investors can move their portfolios into cash (which has a zero interest rate by construction) rather than holding bonds with negative rates.[8] In this article, I follow Eggertsson and Woodford (2003) and Christiano, Eichenbaum, and Rebelo (2011) and make the zero lower bound relevant with a large negative value of the natural rate of interest.

The central bank controls the nominal rate of interest; and its choices influence inflation and the output gap through the Phillips and IS curves. The Federal

Reserve Act mandates that the FOMC use this influence "to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."

The model's central bank fulfills such a mandate by choosing interest rates to minimize the loss function in equation 4. It penalizes current and future deviations from zero of inflation and of the output gap.[9] The coefficient λ gives the central bank the relative weight on its output stabilization objective.[10] The central bank uses the firms' discount factor, β, to evaluate the trade-off between current and future losses. Woodford (2003) and Galí (2008) both give derivations of this loss function as quadratic approximations of households' welfare. Under this interpretation, both inflation and deflation distort the relative prices of goods; and positive and negative output gaps move households away from their desired allocation of time between labor and leisure.

The central bank's choice of i_t directly influences the current output gap through the IS curve and, thereby, indirectly influences inflation through the Phillips curve. However, this traditional static view of monetary policy is incomplete because producers and consumers base their decisions not merely on current policy, but also on their expectations for future inflation and output. It is this channel that makes forward guidance potentially useful.

Discretionary monetary policy

One cannot appreciate the value of commitment without understanding outcomes in its absence, so I begin with a review of monetary policy under discretion. By *discretion*, I mean that the central bank can set the current interest rate but has no direct influence over future rates until the future itself arises. As discussed earlier, a discretionary central bank takes no account of how expectations of its current actions influenced past behavior because those bygones are just that, bygones. There is little room for central bank communication to alter macroeconomic outcomes, because the only credible forward guidance simply describes what the central bank will find to be optimal when the time comes. Campbell et al. (2012) place such statements in the category of Delphic forward guidance.

Since future interest rates determine future inflation rates and output gaps, the only terms in the central bank's loss function under its current control give the *current loss*, $\frac{1}{2}(\pi_0^2 + \lambda\tilde{y}_0^2)$. The discretionary central bank's optimal interest rate minimizes this current loss by taking as given $\tilde{y}_1$, π_1, m_0, and r_0^n.

The divine coincidence

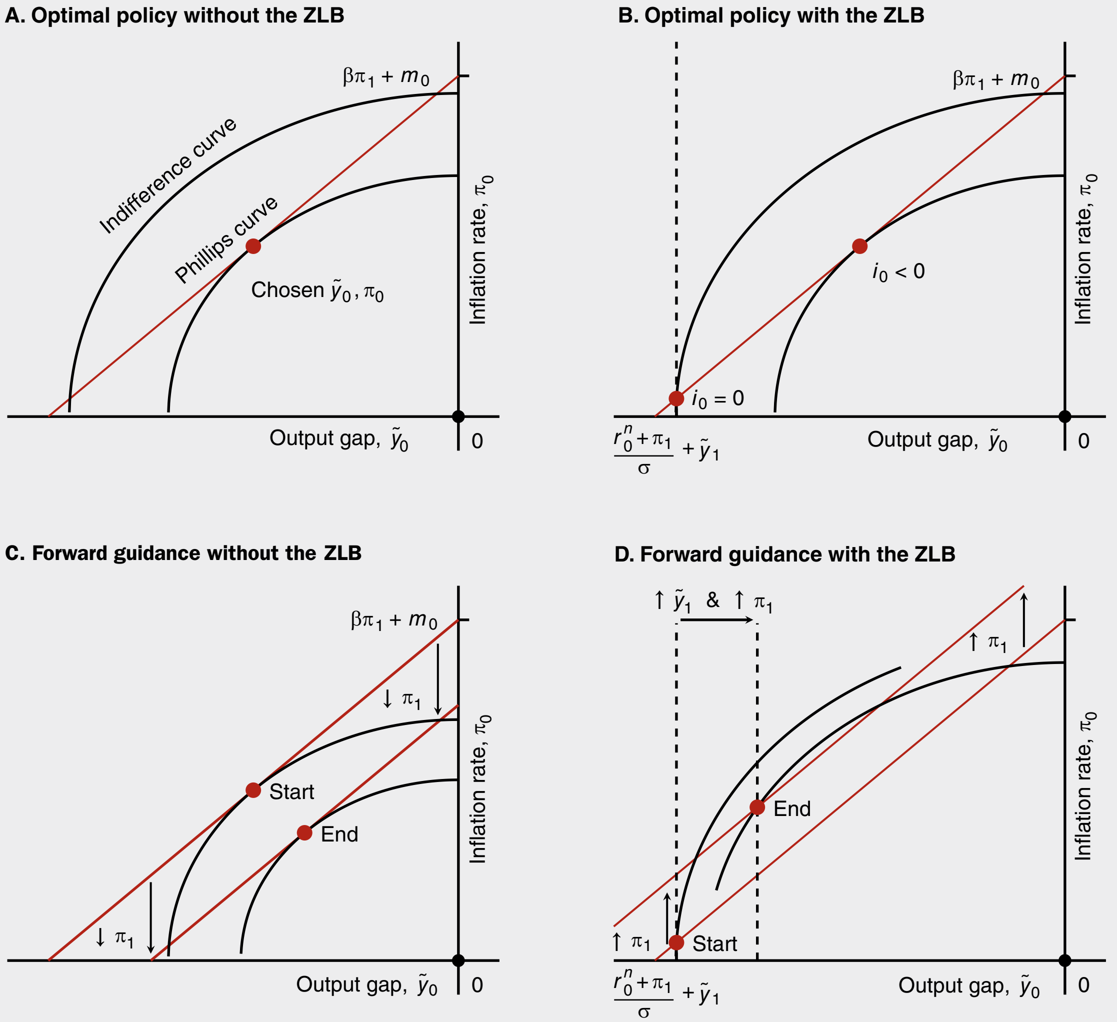
I begin consideration of this choice with the very special case in which $m_t = 0$ and $r_t^n \geq 0$ always. If fortuitously both $\tilde{y}_1$ and π_1 also equal zero, then the IS curve allows the central bank to achieve a zero output gap by simply setting i_t to r_t^n. Since $\beta\pi_1 + m_0 = 0$, the Phillips curve translates a zero output gap into zero current inflation. That is, if future inflation and the cost-push shock both equal zero and the natural rate of interest is positive, then the central bank can achieve the minimum possible loss by completely stabilizing both the output gap and inflation. Blanchard and Galí (2010) have referred to a similar result in a more complicated model as a "divine coincidence." The Phillips curve, which determines which inflation and output gap combinations are feasible, passes through the best possible such combination, no inflation and no output gap. One might object that this superior outcome merely reflects the good fortune of inheriting expectations of price and output stability, but the fact that the central bank wishes to achieve such stability gives one reason to believe that it will occur. Indeed, if both $\tilde{y}_2$ and π_2 equal zero, then the central bank can and will achieve complete macroeconomic stability in period 1. Continuing in this fashion yields the following result: If $m_t = 0$ always and r_t^n is never negative, then the interest rate rule $i_t = r_t^n$ is feasible and achieves complete macroeconomic stabilization. To prove the result to yourself, simply note that the sequences $\tilde{y}_t = 0$ and $\pi_t = 0$ satisfy both the Phillips and IS curves if $r_t^n = i_t$ always. Furthermore, this interest rate choice minimizes the current loss, so households and businesses should expect the central bank to follow it.

The output-inflation trade-off

When $\beta\pi_1 + m_0$ differs from zero, the central bank cannot achieve complete stabilization because the Phillips curve no longer passes through the origin. In this case, the discretionary central bank faces a classic output-inflation trade-off. Panel A of figure 1 illustrates this trade-off with a familiar indifference curve budget-set diagram. Here, the Phillips curve (in red) plays the role of the budget constraint. The central bank can choose any inflation-output gap combination on the curve. Its slope equals κ, and it crosses the vertical axis at $\beta\pi_1 + m_0$. The family of indifference curves comes from the central bank's loss function. Each one gives the inflation-output gap combinations that yield a constant value for the *current* loss function. If λ equals one, each indifference curve is a circle. In general, the curves are ellipses, but I have drawn only their portions in the northwest quadrant. The points on an indifference curve that lie inside of another give a lower total loss. If the central bank were to choose an inflation-output gap combination with an indifference curve that *crosses* the Phillips curve, then it could achieve a lower loss by sliding away from the closest axis along the Phillips

FIGURE 1

The inflation-output gap trade-off



Note: ZLB indicates zero lower bound.

curve. Therefore, the Phillips curve must be *tangent* to the best possible point's associated indifference curve. This is marked in the figure with the red point labeled "Chosen $\tilde{y}_0$, π_0." The central bank tolerates both higher-than-desired inflation and lower-than-desired output as the best feasible outcome. The exact inflation-output gap chosen balances the loss from increasing inflation slightly with the loss from slightly deepening the recession.

The nominal interest rate is notable in this standard analysis of the output gap-inflation trade-off only by its absence. The Phillips curve *alone* determines the output-inflation trade-off. So long as the desired output gap is not below what can be achieved by setting i_0 to zero, the IS curve merely determines the nominal interest rate that guides the private sector to the central bank's favored outcome. The IS curve becomes more relevant to the problem when the ZLB on i_0 constrains the central bank. To see how, isolate i_0 on the left-hand side of equation 2, substitute the resulting right-hand side into the ZLB in equation 3, and arrange the result to put $\tilde{y}_0$ on the lower side of the inequality,

$$\tilde{y}_0 \leq \tilde{y}_1 + \frac{r_0^n + \pi_1}{\sigma}.$$

That is, the ZLB and IS curve together put an *upper bound* on the output gap. When this upper bound is a negative number, it can be interpreted as a lower bound on the size of a recession. If this lower bound is high enough, then conventional interest rate policy cannot mitigate a recession. Panel B of figure 1 depicts the central bank's choice in this case. The dashed vertical line indicates the location of the upper bound on $\tilde{y}_0$. Without the ZLB, optimal monetary policy would guide the economy to the tangent point marked "$i_0 < 0$." The ZLB moves the actual outcome southwest along the Phillips curve to the point marked "$i_0 = 0$," where the Phillips curve intersects the vertical line. Since the central bank's indifference curve is steeper than the Phillips curve, it would like to reduce the current output gap at the expense of higher inflation. However, the ZLB prevents it from doing so. This illustrates how conventional monetary policy at the ZLB is "too tight."

Monetary policy with commitment and communication

Both the Phillips curve and IS curve are forward looking, so each of them can serve as a channel for forward guidance to influence current macroeconomic outcomes. Panels C and D of figure 1 illuminate these channels. Suppose that the central bank could credibly influence private expectations about inflation in year one. Lowering π_1 directly shifts the Phillips curve down and, thereby, expands the set of possible current output gap-inflation outcomes. Panel C illustrates this situation, in which forward guidance moves inflation and the output gap toward their desired levels. Economically, a credible promise of future disinflation lowers producers' current desired prices and, thereby, allows the central bank to achieve a given level of current inflation with a smaller output gap. Of course, the promised deflation and its accompanying output gap also cost the central bank. The size of the cost depends on the initial values for π_1 and $\tilde{y}_1$. If a substantial deflationary recession was already anticipated, then fighting current inflation with forward guidance might be too costly. On the other hand, if both π_1 and $\tilde{y}_1$ begin at zero, then slight changes to them have very, very small costs.

Since the IS curve is irrelevant for discretionary monetary policy away from the ZLB, it should be no surprise that forward guidance works through the IS curve only when the ZLB constrains policy. Panel D of figure 1 shows how forward guidance can influence outcomes in this case. The upper bound for $\tilde{y}_0$ derived from the IS curve and the ZLB constraint increases in both π_1 and $\tilde{y}_1$, so this lower bound shifts to the right if the central bank's promises of low future interest rates increase expectations of inflation, the output gap, or both in year one.

If this were the end of the story, the forward guidance would slide the inflation-output gap outcome along a fixed Phillips curve. However, the increase in promised inflation also shifts the Phillips curve up. As drawn, the cost of the additional current inflation is less than the benefit from the reduced output gap. (The indifference curve running through the point marked "End" is interior to the one passing through "Start.") Just as in the case displayed in figure 1, whether this improvement in current outcomes is worth the required change in π_1 and $\tilde{y}_1$ will depend on their initial levels. If the central bank inherits expectations of future macroeconomic stability, then the cost of forward guidance is small.

Optimal monetary policy as a path

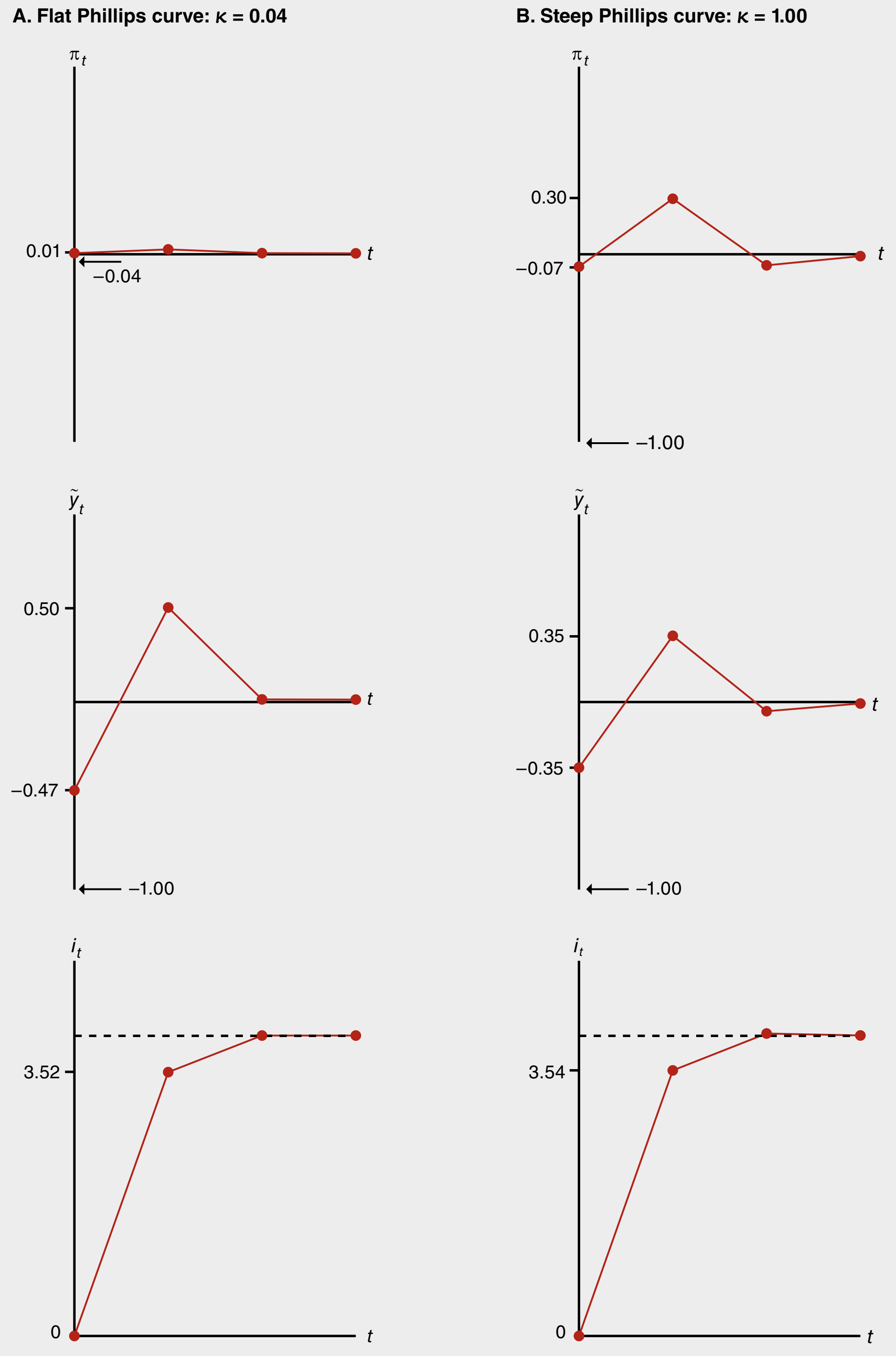
The same constraints that limit the central bank's actions in year zero also apply to future years, so this discussion of forward guidance would be incomplete if it stopped at figure 1. To bring future years' Phillips curves and IS curves into the picture, consider the problem of a central bank in year zero choosing values for π_t, $\tilde{y}_t$, and i_t from year zero into the infinite future. The central bank chooses these to minimize the loss function in equation 4, but the chosen sequences must satisfy the Phillips curve, IS curve, and ZLB in equations 1, 2, and 3 for *all* years. This dynamic formulation of the monetary policy problem is necessary for the full consideration of forward guidance, because it allows the central bank to quantitatively compare the current gains from forward guidance with the future costs of following through on promises made. Because Ramsey (1927) first conceived of economic policy as choosing a vector of economic outcomes to achieve the lowest social cost possible subject to the constraints imposed by private decision-making, economists call this a Ramsey problem and its policy prescription a Ramsey solution. In this particular context, the central bank's loss function determines the social cost of specific sequences for the output gap and inflation, and the constraints imposed by private decision-making are the Phillips curve, IS curve, and ZLB.

The Ramsey outcome can be best appreciated by studying an example calculated from a particular parameter configuration. To impose a neutral interest rate of 4 percent, the example set $\beta = \exp(-0.04)$. Evans (2011) discusses the numerical values for λ consistent with the Fed's dual mandate of promoting maximum employment with stable prices, and the example uses his preferred value $\lambda = 0.25$. The absolute intertemporal elasticity of substitution σ equals one; so a 1 percent reduction in the natural interest rate lowers the output gap's upper bound by 1 percent.

Figure 2 shows the sequence of output gaps and inflation rates that minimize the central bank's loss function with these parameters when a temporarily negative natural rate of interest drives the economy to the ZLB in year zero. That is, $r_0^n = -0.01$ and $r_t^n = 0.04$ for $t \geq 1$. (The markup shock that placed the analysis of figure 1 into the northwest quadrant

FIGURE 2

Optimal policy with one year at the zero lower bound



equals zero here.) The figure reports results for two values of κ, 0.04 and 1.00. The smaller "flat" value of κ is of the magnitude favored by Eggertsson and Woodford (2003). It requires a 20 percent decrease in the output gap to lower inflation by 1 percent. One might judge such a large sacrifice ratio to be unrealistic, because actual disinflations (such as that engineered by Paul Volcker in the early 1980s) have not generated such large output declines. The relatively larger value for κ addresses this possibility.

In figure 2, the black arrows pointing to the vertical axes indicate each variable's value in year zero without forward guidance. (In all future years, the discretionary values of π_t, $\tilde{y}_t$, and i_t are zero, zero, and 0.04, respectively.) By construction, discretionary monetary policy can do nothing to mitigate the effects of hitting the ZLB. The negative 1 percent natural interest rate drives $\tilde{y}_0$ to −1 percent, irrespective of the Phillips curve's specification. The Phillips curve's slope determines the size of the associated disinflation. With the flat Phillips curve, this equals only –4 basis points, but with the steep Phillips curve, inflation falls 1 full percentage point.

When the central bank instead employs forward guidance, the decline in the output gap is substantially reduced, to –47 and –35 basis points with the flat and steep Phillips curves, respectively. To achieve such moderation of the initial recession, the central bank engineers a future inflationary expansion. In year one, the output gap equals 50 and 35 basis points with the flat and steep Phillips curves, respectively. With the flat Phillips curve, inflation in year one is hardly noticeable, but it equals 30 basis points with the steep Phillips curve. More noticeable is the effect of forward guidance on year zero inflation when the Phillips curve is steep. It rises from –1 percentage point to –7 basis points. The experiments with both slopes feature very small deviations from steady state after year one, and they have nearly identical associated paths for the interest rate. By construction, $i_0 = 0$. The interest rate equals about 3.54 percent in year one and thereafter stays very close to the natural rate.

These numerical results illustrate two principles emphasized by Eggertsson and Woodford (2003). First, optimal monetary policy at the ZLB resembles the prescriptions of *price-level targeting* (PLT). Under PLT, the central bank announces targets for a relevant price index, such as the deflator for consumer expenditures excluding food and energy goods, for several dates. The central bank then chooses policy in order to come as close as possible to these targets. If inflation falls short of its expected value, then the central bank deliberately tolerates a later overshooting of inflation, which brings the price level closer to its stated target. Qualitatively, this policy can be seen in the optimal inflation path with a steep Phillips curve. The deflation of 7 basis points is followed by an inflation of 30 basis points. Recall that even if the ZLB does not bind, a central bank facing an output-inflation trade-off resulting from an inflationary markup shock would like to promise deflation in the future to move the Phillips curve back toward the origin. The inflation followed by deflation also resembles the PLT outcome. Eggertsson and Woodford (2003) provide a more extensive but similar argument that PLT should always be followed, both at and away from the ZLB.

The second principle can be seen in the accommodative interest rate in year one: Optimal forward guidance promises to maintain an expansionary monetary policy *after the conditions that initially warranted it have passed*.

Conclusion

Since economic growth remains below potential, inflation is running below the FOMC's target of 2 percent, and the ZLB prevents further conventional monetary accommodation, the FOMC has turned to two nontraditional monetary policy tools, quantitative easing and forward guidance. This article has shown how the latter, through "open mouth operations," can improve current macroeconomic outcomes by altering current expectations of future inflation and output. In the Ramsey problem, the central bank's ability to manipulate expectations is assumed to be perfect. Campbell et al. (2012) review the considerable evidence that FOMC members did indeed influence private expectations before the financial crisis, and they expand upon it by showing that FOMC statements continued to move asset prices in the post-crisis period. Such influence is undoubtedly helpful for implementing forward guidance, so it seems reasonable to assume that FOMC participants have built up enough influence with the public to credibly commit to forward guidance.

This primer reviewed the *theory* of such guidance, but the question of how well the FOMC's current guidance matches that of the theory remains open. In the simple model I used to solve the Ramsey problem, the natural interest rate follows a simple predetermined path and there are no markup shocks. In practice, both the FOMC and the public face considerable uncertainty about the path of the natural interest rate. Furthermore, shocks to supply (through the markup shock) and demand (through the natural interest rate) continue to impact the economy even though they are more pedestrian than those that caused the financial crisis. Mimicking the Ramsey solution in such circumstances would require the FOMC to specify a comprehensive rule for its interest rate decisions and associated forecasts for inflation and the output gap. In such a complex world, where the possible sources of future economic turbulence cannot even be reliably listed (not to mention quantified), such a complete solution is unrealistic.

What the FOMC has done instead is provide *threshold-based* guidance. The Committee expects the current interest rate of approximately zero to remain appropriate at least as long as the unemployment rate remains above 6.5 percent and medium-term inflation expectations remain below 2.5 percent. This guidance can be consistent with the "overshooting" prescription of the Ramsey solution. Of course, the simple model presented here gives just a qualitative guide to optimal forward guidance. The more sophisticated model of Eggertsson and Woodford (2003) differs from it only by randomizing the time at which the natural rate of interest permanently returns to its long-run value, so that provides hardly more quantitative guidance for the current situation. Extending this policy framework to include a more realistic random evolution of r_t^n and ongoing markup shocks is the subject of current research.

NOTES

[1]The full press release from the September 18, 2013, FOMC meeting is available at www.federalreserve.gov/newsevents/press/monetary/20130918a.htm.

[2]See www.federalreserve.gov/boarddocs/press/general/2000/20000202/default.htm.

[3]See www.federalreserve.gov/boarddocs/press/general/2001/20010821/default.htm.

[4]See www.federalreserve.gov/newsevents/press/monetary/20081216b.htm.

[5]See www.federalreserve.gov/newsevents/press/monetary/20120913a.htm.

[6]See www.federalreserve.gov/newsevents/press/monetary/20121212a.htm.

[7]Since it corresponds to no specific market interest rate, r_t^n cannot be directly observed. However, it can be inferred from observations of actual interest rates and households' consumption and savings decisions. See Justiniano and Primiceri (2010) for a review of this procedure.

[8]One might object that the simple model economy at hand has no cash, only one-period bonds. Woodford (2003) asserts that adding cash to the model leaves its basic economics unchanged. This article uses the cashless version of the New Keynesian model to maintain simplicity.

[9]Virtually by definition, bringing the output gap closer to zero improves social welfare. However, zero inflation is not necessarily the socially optimal definition of "price stability." Reifschneider and Williams (2000) discuss this in more detail. For simplicity, this primer abstracts from this issue by defining "price stability" with a zero inflation rate.

[10]One might object that the output gap appears in equation 4 rather than an analogously defined employment gap. Since Okun's law connects these two gaps, the stabilization of the output gap is indeed consistent with the Fed's dual mandate. See Evans (2011) for a discussion of this issue.

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