Discussion by Gauti Eggertsson

When the Federal Reserve cut the nominal interest rate down to zero in response to the crisis of 2008 it started relying to an increasing extent on what has been termed "forward guidance". Even if it could cut the interest rates no more, it could still have an effect on the market perception of *future Federal Fund Rates*.

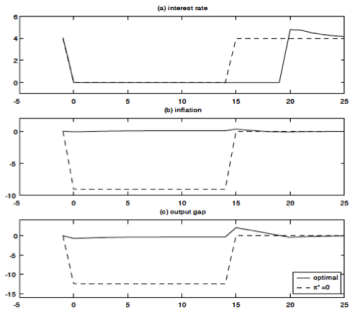
This paper tries to answer the following questions: First, did forward guidance have any effect according to high frequency data from financial markets? If so, what were they? Second, the authors study a medium scale DSGE model and attempt to address the same question from the perspective of a structural model. This is an incredibly ambitious paper, a great piece of work, that is trying to answer one of the major macroeconomic questions today. It marks the beginning of a debate that I suspect we will be having for quite long time going forward.

Building on previous work by a subset of the authors (Campbell, Evans, Fisher, and Justiniano (2012)) they define Delphic forward guidance as one which reveals something about future fundamentals for a given policy, while Odyssean forward guidance is explicit communication about future policy, and I will try to clarify below how I believe we should think about this. As we will see, Delphic forward guidance that lowers future nominal interest rates will then tend to be contractionary while Odyssean forward guidance will be expansionary. Forward guidance can thus in principle either have made the crisis worse or better: That is an empirical question the authors attempt to address. Broadly speaking, the authors do find evidence that forward guidance had meaningful effects on economic variables. According to their reduced form empirical results, Delphic forward guidance accounts for a non-trivial amount of the variation in federal funds future rates on FOMC announcement days. Moreover their structural model suggests an intriguing result: Forward guidance was on net contractionary from 2008 to 2011 but then became expansionary thereafter. Before proceeding, I find it useful, motivated by the paper, to clarify a bit how I like to think about forward guidance in theory via a simple model. I then offer comments on the results.

1 Forward Guidance in Theory

Figure 1 is from Eggertsson and Woodford (2003). It shows the solution of a standard New Keynesian model under optimal monetary policy with commitment at the zero lower bound (solid line) and compares it with a policy that targets zero inflation whenever possible. The figure shows what happens under these two policy regimes in the case the natural rate of interest is negative for 15 periods, for output, inflation and the short-term nominal interest rate.

If the central bank were to target zero inflation, it would raise the nominal interest rate as soon as the shock is over and achieve zero inflation without any output gap from period 15 onwards. This is the dashed line. The problems is



that in this case there is no policy accommodation from period 0 to period 15, due to the ZLB, which leads to a big recession. The optimal policy commitment, instead, achieves a much better outcome by the central bank pledging to keep the nominal interest rate at zero even after the shock is over (from period 15 to 20), thus accommodating an output boom once the shock is over and modest inflation. The result of this commitment is to essentially do away with the recession in periods 0-15 by lowering the real interest rate during the time the ZLB is binding and creating expectations of higher future income.

This example is sometimes used to motivate forward guidance. Imagine we are in the zero inflation policy regime, which can for example be motivated by a standard Taylor rule with a zero implicit inflation target (nothing changes by having the inflation target higher in terms of the logic of the result). Then all you have to do – taking the figure literally – is to say you will keep the nominal interest rate at zero beyond the time at which the shock is over for five extra periods. This, then, should increase the demand and presumably move the economy from the dashed line closer to the sold line.

The authors have in earlier work emphasized one problem with this interpretation when applied to real world policy. Suppose forward guidance is simply an unconditional announcement of the nominal rates being lower in the future than people previously anticipated. You thought we would keep the nominal interest rate low for one more year? Guess what: It is now two years! The problem with an announcement of this kind is this: How should the public interpret it? While one interpretation would be that the central bank is moving from a low inflation targeting regime like in the figure above, to something closer to full commitment, there is another possibility. What if the public instead interprets this as signalling nothing about the monetary policy regime but instead that the Federal Reserve is just more pessimistic about the future due to weaker fundamentals? In this case there seems little reason to expect the "forward guidance" to be expansionary. Instead one may very well expect it to be contractionary. The authors call the former type of forward guidance Odyssean – it commits the central bank to changing its policy rule – while they term the second one Delphic – nothing has changed in terms of policy, the outlook is now just darker than before.

2 A Simple Model

Before going further I thought that it would be useful to firm up this insight by illustrating it in a modest variation of the New Keynesian model. Let us denote output in deviation from steady state $\hat{Y}_t$, inflation by π_t, the nominal interest rate by i_t and the natural rate of interest by r_t^n. This is the real interest rate the central bank needs to achieve for output to be at potential. Finally, let us denote peoples expectations about future variables by $\tilde{E}_t$ where I put the tilda on top of the expectation operator – and here I am being "loose" – to distinguish it from our typical rational expectation operator, as this belief function of the public may or may not be pinned down by the true data generating process underlying the model. The model is then summarized by

$$\hat{Y}_t = \tilde{E}_t \hat{Y}_{t+1} - \sigma(i_t - \tilde{E}_t \pi_{t+1} - r_t^n)$$

$$\begin{aligned} \pi_t &= \kappa \hat{Y}_t + \beta \tilde{E}_t \pi_{t+1} \\ i_t &= \max(0, r_t^n + \phi_\pi \pi_t + \epsilon_t) \end{aligned}$$

and can be easily solved by making explicit assumption on the stochastic process r_t^n. Let us suppose that the public believes that r_t^n follows a two state Markov process as in Eggertsson and Woodford (2003), whereby $r_t^n = r_S^n$ in period 0 and then reverts back to an absorbing steady state $r_t^n = r_L > 0$ with a perceived probability of $1 - \mu$ at each time. Let us denote the stochastic time period in which it is back to normal by τ. In addition to this, let us assume that the monetary policy follows the policy rule as specified above with $\epsilon_t = 0$ for all time periods, except the time at which the shock reverts to steady state τ, in which case it may take on a different value denoted ϵ_τ^M.

Under these assumption it can be shown that in the long run, i.e., for $t > \tau$ there is only one bounded solution at a positive interest rate given by $\pi_L = \hat{Y}_L = 0$ and $i_L = r_L$.[1] Taking this as given, the solution at time τ (the "medium run") is given by

$$\hat{Y}_M = \frac{-\sigma}{1 + \sigma \phi_\pi \kappa} \epsilon_M$$

and

$$\pi_M = \frac{-\sigma \kappa}{1 + \sigma \phi_\pi \kappa} \epsilon_M$$

Using these two expression it can finally be shown that the solution in the short run, i.e. at all times $0 < t < \tau$ the solution for output is given by

$$\hat{Y}_S = -\psi(\mu) \epsilon_M + \gamma(\mu) r_S^n \tag{1}$$

[1] Here we are deliberately ignoring the possibility that the ZLB may be binding due to self-fulfilling expectations.

where the coefficients $\psi > 0$ and $\gamma > 0$ are defined in the footnote and $\psi'(\mu) < 0$ and $\gamma'(\mu) < 0$.[2] We can also solve for the expected nominal interest rate in the medium term to obtain

$$E_S i_M = (1-\mu)i_M + \mu * 0 = (1-\mu)r_L + (1-\mu)\frac{1}{1+\sigma\phi_\pi\kappa}\epsilon_M \qquad (2)$$

Expression (1) and (2) reveal two basic insights that put a bit of structure on the key argument the authors make about the nature of forward guidance. First, observe that output depends on the public belief about future monetary policy ϵ_t^M once the ZLB is no longer binding. In particular we see that if the central bank commits to keeping the nominal rate lower in the medium run when the ZLB is no longer binding this will unambiguously increase output in the short run. Moreover, and perhaps somewhat obviously, we see by expression (2) that this will lower peoples expectations about medium term interest rates. Hence this is an example of a successful expansionary *Odyssian forward guidance*. The formulas above, however, also reveal another result. Set $\epsilon_M = 0$ and imagine that the government makes an announcement that has an effect on the private sector belief about the duration of the shock, i.e., the public belief about μ, a variable that in principle could depend on various "fundamentals". According to formula (1) this will unambiguously lead to a contraction in output, as $\gamma'(\mu) < 0$. Moreover, we see in formula (2) that this will also lead to lower expectations of future interest rates.

The bottom line then is that in and by itself, if the public is not certain about μ or ϵ_M, the Federal Reserve announcement about lower future nominal interest rates could be interpreted in one of two ways, i) it signals a more pessimistic view about the evolution of the economy (higher μ) or ii) it signals that the central bank will set interest rates in the future lower for given fundamental (lower ϵ_M). Importantly, while ii) is unambiguously expansionary as in Eggertsson and Woodford (2003) we see that the first type of communication is contractionary. In theory, then, if we suppose that Federal Reserve communication may not only reveal something about its own policy reaction, but also something about underlying economic fundamentals, forward guidance defined as credible communication about future nominal interest rates has an ambiguous effect on output, depending on if it is Odyssian or Delphic.

3 What did the Fed do?

What was the Federal Reserve attempting to do post 2008? Was it trying to signal something about future fundamentals or trying to convey something about policy? One interesting aspect of this period, is that people inside the Fed — and outside it – did not even agree on the answer to that question at the time, and do not agree on it now either. I have heard people inside and outside

[2] Where we have defined $\psi \equiv -\frac{(1-\mu)(1-\beta\mu+\sigma\kappa)}{(1-\beta\mu)(1-\mu)-\mu\sigma\kappa}\frac{\sigma}{1+\sigma\phi_\pi\kappa}$, $\gamma \equiv \frac{\sigma(1-\beta\mu)}{(1-\beta\mu)(1-\mu)-\mu\sigma\kappa}$ and assume the parameter restriction $(1-\beta\mu)(1-\mu) > \mu\sigma\kappa$ as in Eggertsson (2011).

of the Fed take both sides of this argument, some claiming the communication implied no futher commitment while others saying it did. I find it useful to think of the Federal Reserve communication as having in the beginning largely relied on time dependent commitment up until about late 2012, at which time the Federal Reserve started to adopt more explicit thresholds or state contingent commitment. As we will see, one can well argue that these communications had different implications in theory. Indeed one interpretation of the results presented in this paper is that the time contingent commitments pre 2012 were Delphic, while the state contingent commitments post 2012 were Odyssian. I would not go that far, however.

My own interpretation of this period, having been at the Federal Reserve Bank of New York at the time and observed day to day gyrations of the market closely, was that several of the policy announcement had strong Odyssean effects, even those that seemed purely to refer to time horizons, e.g. the statement that the rates would stay low for "some time" (December 2008), for "extended period" (March 2009) and "at least to mid-2013" (August 2013). I would even go so far to suggest that some of these announcement had a strong Odyssean effect, even when some policy makers seemed to explicitly protest to the market that they did not imply any firm commitment.

The way I rationalized this point of view at the time – and still do – may seem a bit contradictory It is that by stating specific dates, or horizons, the Federal Reserve made keeping rates low a "default option". In this case in most peoples mind it was made costly to deviate from this default – it required explanation. I have yet to see anyone formalize this notion, but my hunch is that this is what was going on, indeed I suspect that the forward guidance language was helpful in achieving accommodation throughout the recovery period and thus preventing inflation to fall further. Yet, I also agree with the authors – and it was also my impression at the time – that forward guidance as practiced was sometimes a double edged sword due the problem that the market could interpret the communication as signalling economic weakness rather than a more aggressive policy stance. Moreover, I do think there were occasions when the policy language might have had this negative effect. The FOMC announcement in August 2011 being a prime suspect (see Del Negro, Giannoni and Peterson (2012)). But before going further, it is worth asking, can one do better in theory?

4 What is effective forward guidance?

As we have just seen, one problem with forward guidance, when used in terms of giving signals about lower future nominal interest rates is that it can be contractionary if people interpret the language as signalling bad fundamentals. How can this problem be addressed? This was actually a question that Michael Woodford and I asked ourself more than 13 years ago in Eggertsson and Woodford (2003). What we showed in that paper was that the Federal Reserve could in fact specify their optimal policy commitment via "thresholds" (although we

did not use that name at the time). In particular we showed in a simple New Keynesian model that if the Fed said it would keep the interest rate at zero until a particular target was achieved, which was defined as a weighted average of the price level and the output gap, it could replicate the full commitment equilibrium. Perhaps most interestingly we showed how one could compute this criterion (which was supposed to creep upwards the longer the ZLB lasted) without needing any estimate for the shock hitting the economy $\dot{r}_t^n$ or the persistence parameter of the shock μ. All one needed was information about the output gap and the "deep" structural parameters of the model.

This result implied that the Federal Reserve did not need to signal anything about how long the zero lower bound would be binding – instead – it should simply specify the criterion that had to be met for raising rates. The market could then infer by itself the implied duration of the ZLB, and the Delphic/Odyssean signalling problem would be gone altogether.

I think it is fair to say that the policy adopted by the Federal Reserve in December 2012 came a lot closer to this ideal when it adopted what the authors call the Evans rule, when the Federal Reserve said it would "keep the target range .. at 0 to $\frac{1}{4}$ and currently anticipates that this .. will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between on and two years ahead is projected to be no more than half a percentage point above the Committee's 2 percent longer-run goal. . . ." While this was not exactly the Eggertsson and Woodford (2003) formula it was a lot closer, in the sense that it stated conditions needed for raising rates – letting the market do the computing of liftoff itself – and promising to hold off lifting rates even if there would be some slight overshooting of inflation, conditional on it not been projected to be too far off in two years ahead forecasts of inflation.

5 Empirical measures of forward guidance in practice

We have just seen that forward guidance if interpreted as simply stating a forecast about future Fed Funds rate could either be contractionary or expansionary, depending on how people interpret the reason for the forecast. We have also seen how effective forward guidance can be done in theory with thresholds. What does high frequency data say about the effect of forward guidance? The authors results suggest that a large part of forward guidance done by the Fed was in fact Delphic in nature.

One interesting idea in the paper is to look at the response of markets to Fed announcements taking into account the forecast of both the Fed and market participants. In particular the paper looks at the forecast from the Federal Reserve Greenbook about economic fundamentals (inflation, GDP and unemployment) and subtract from it the analogous consensus forecast from the Blue-chip survey, which is a survey of Wall Street forecasters. The authors suggests that we should interpret this difference as a measure of Delphic forward guidance, i.e.

the extent to which the statements of the Federal Reserve reveals something about economic fundamentals (μ in the language of the simple model above). Hence if the Fed is forecasting a grimmer outlook than that of the private sector, this will show up in their proxy. This interesting proxy accounts for about 20 percent of variation in the unexpected changes in expected Fed Funds rate in the data. This, then, suggests plenty of room for Odyssean guidance or what I term ϵ_M in my model above.

One problem with this interpretation is that there is another natural candidate for why the Feds views and the private sector could differ on fundamentals as captured by this proxy. Suppose that instead Fed has knowledge about the future Federal Funds Rate policy function that is unknown to the private sector prior to the meeting, i.e., knowledge about ϵ_M in our example above. The Federal Reserve goes into the meeting more optimistic than the private sector because it is aware it is just about to reveal a more a plan for more expansionary policy. In some respects this also seems like quite a natural assumption, since if the Federal Reserve has private information about anything, presumably its own actions would be high on the list. I see no particular reason for why one could not interpret the authors proxy in this way. One problem, however, with this interpretation is that this type of policy communication should be expansionary, while as the authors show it works in the opposite direction. I think it is fair to say, therefore, that the empirical results presented here are still quite open to different interpretations, although I tend to agree with the authors one (but this is simply because then the response coefficient is consistent with my own prior).

Some additional evidence that looks to me to be quite compelling, and complimentary to the evidence presented here, are presented in Del Negro, Giannoni, and Patterson (2012). They show, via event analysis, that time dependent forward guidance of the form made in August 2011 likely was Delphic in nature, or contractionary, while the one in September 2012 was Odyssian, or expansionary, when the Federal Reserve said it anticipated that a "highly accommodative stance ... will remain appropriate for a considerable time after the economic recovery strengthens .... at least through mid-2015". These authors estimate significant effects of this announcement on GDP growth and inflation.

6 Time dependent forward guidance and threshold based one?

One reading of this paper, especially the modeling part, is that forward guidance was largely contractionary from 2008 to 2011 when it mainly focused on giving guidance about future dates at which rates would increase. It then became expansionary as the forward guidance took a slightly different form and started becoming contingent of economic outcomes – or thresholds – like the December announcement in 2012 that I referred to above. From a theoretical standpoint, one explanation for this could be that forward guidance was largely

interpreted as a signal of bad fundamentals in the beginning of the period, while then becoming expansionary once the communication was put in a more proper "threshold" format.

As I have already suggested above, my own impressions living through this period, was that the forward guidance between 2008-2011 was in fact largely expansionary for the reason I stated above (by making low rates "default") even if on some occasions it had mixed success such as the August FOMC announcement in 2011. My reading of Del Negro et al (2012) confirms that prior. But this leaves me with the question of why the structural model presented here seems to suggest that forward guidance was in fact contractionary until late 2012. Let me offer some speculation on that point, which I suspect we will continue to debate in coming years.

To understand the reason for the result in the authors model, it is useful to observe how they identify forward guidance in their structural estimation. What they do – which is a key innovation and a very clever one – is to look at what their model forecasts the nominal interest rate to be (and the model is estimated on observed ex post data), and then compare it to the market forecast at the time, which they extract from asset markets. To the extent there is a discrepancy between the two, they identify the resulting residual as deviation of the policy rule and as coming about due to forward guidance. A key observation is that the market was expecting a more rapid increase in Fed funds rate pre 2012 than the model, which the authors then interpret as contractionary forward guidance (i.e. a faster normalization than should be implied by the model).

But is appropriate to identify forward guidance in this way? My guess – and this in only a guess – is that here we might be leaning a bit too hard on model consistent expectations – assuming that the model represents reality and that market participants base their forecast on this particular reality. And then estimating the model by maximizing the chance that what we observed in the data in fact represents that underlying data generating process. I am guessing that the reason the market expected faster recovery for the Fed Funds rate than is indicated by the model was not due to forward guidance. Instead, my guess is that the market erroneously assumed at that time that the recovery would be much quicker than we have ended up seeing in the model. I suspect that this type of market miscalculation will be incorrectly identified as contractionary forward guidance in the model. But this is just a conjecture. Finding out the right answer will be on the agenda for future research. And this is an excellent start.

7 References

Campbell, J.R., C.L. Evans, D. Fisher and A. Justiniano (2012): Macroeconomic Effects of Federal Reserve Forward Guidance, Brookings Papers on Economic Activity Spring 2012

Del Negro, M., M. Giannoni and C. Patterson (2012): The Forward Guidance Puzzle, Federal Reserve Bank of New York Staff Report No. 574

Eggertsson, G. (2011): What Fiscal Policy is Effective at Zero Interest Rates? Chapter in NBER Book (2011)

Eggertsson, G. and M. Woodford (2003): The Zero Interest-Rate Bound and Optimal Monetary Policy, Brookings Papers on Economic Activity, 2003:1