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Special Commentary

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Predicting the Probability of FOMC Rate Decisions: An Ordered Probit Approach

What will be the FOMC rate decision? Every six weeks the financial markets consider this critical question. The Federal Open Market Committee (FOMC) sets the stance of the U.S. monetary policy and provides a target for the federal funds target rate (FFTR). This report presents an ordered probit approach that estimates the six-month's-ahead probability of three distinct scenarios of the FOMC decision: raise the FFTR, reduce the rate or keep the rate unchanged. The traditional way of forecasting the interest rate is to predict a single level (point estimate) of the FFTR; however, this approach suffers two problems. First, it is not useful for the option/risk facing decision-makers. Trading/investment strategies are far more focused on the alternatives of raising or reducing the target rate than the single-point estimate for the target rate at 2.00 or 2.50 percent, for example. Second, point estimates of the interest rate convey a sense of overconfidence. Our method is different and more practical for those who must hedge their portfolios, but it is also useful for policymakers, investors and consumers who can attach a probability with each more likely scenario of future FFTR trends: increasing, decreasing or unchanged.

This report presents a model that estimates the six-month's-ahead probability of three distinct scenarios of the FOMC decision.

One key suggestion of our ordered probit model, which may be crucial, is that since June 2013, the probability of a rate reduction has trended downward. Currently, based on the April 2014 data, the probability is 21 percent, which is the lowest since December 2007. At the same time, the model has predicted an increasing probability of a rate hike since June 2013 and, based on the April 2014 economic data, the probability of a rate hike is also 21 percent. This pattern implies that there is a significant chance of a change in the stance of the monetary policy in the near future and that this chance should be priced into financial assets. In addition, a persistently higher probability for a particular FOMC rate decision scenario is consistent with the episodes in the 1990s and 2000s when the model predicted a relatively higher probability for an extended period of time for a particular stance of monetary policy, and that prediction was matched with the subsequent FOMC rate decisions.

Importance of Predicting Probabilities of the FOMC's Rate Decision

The FOMC usually announces its target for the FFTR in regularly held meetings. These announcements are very important for market followers in the public and private sectors. The FFTR is a vital benchmark for borrowing costs and an increase in the funds rate raises borrowing costs, at least in nominal terms. Furthermore, a movement in the FFTR indicates the FOMC's expectations about the economy (in particular, prices and the labor market). Typically, the FOMC raises the FFTR in response to a better economic outlook and to combat anticipated inflationary pressure. On the other hand, to stimulate the economic activity, the FOMC tends to reduce the target rate. The direction of the change (positive versus negative, or no change) in the FFTR is important. In addition, by attaching a probability to each likely scenario of FOMC decisions about the target rate, decision-makers are better prepared to develop efficient sets of responses for each possible scenario.

The majority of FFTR forecasters predict a future interest rate for a certain future period and compare that to the FOMC two-year-out forecast for FFTRs. Our thesis is that it would be

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beneficial to assign a probability to each likely scenario of the rate decision for the near future. One major reason is that budgetary planning and policy implications would be different for a lower interest rate outlook compared to higher interest rate expectations. Investors want to know the up/down bias to the FOMC's outlook. Therefore, instead of generating a specific single number for the future FFTR (a prediction of 1.0 percent for one-year ahead, for example), it would be much better to generate probabilities of each rate decision scenario.

Figure 1

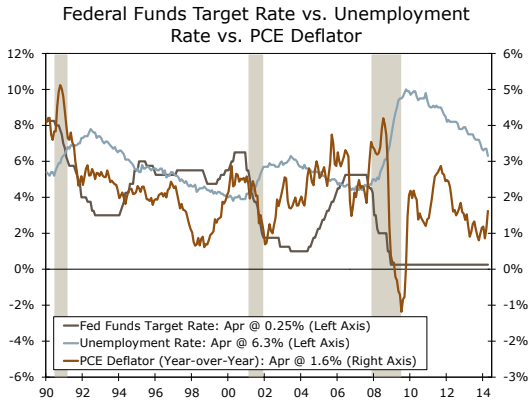
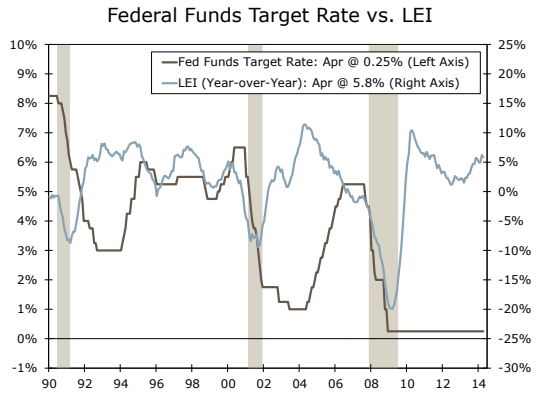


Figure 2



Source: U.S. Dept. of Labor, U.S. Dept. of Commerce, Conference Board and Wells Fargo Securities, LLC

Econometrics of the Ordered Probit Modeling

This report utilizes an ordered probit framework to generate probabilities of three distinct scenarios of the FOMC's rate decision: raising the FFTR (or contractionary monetary policy), rate reduction (or expansionary monetary policy) and an unchanged rate. In the ordered probit modeling, a dependent variable can take a finite number of values possessing a natural ordering.[1]

The final model includes the following predictors: the unemployment rate, the PCE deflator and the LEI.

In the first step, using the FFTR series, we create a dependent variable for the ordered probit model. Specifically, a categorical-variable (Y= -1, 0, 1) is created: Y equals negative one (-1) if the FOMC reduces the target rate, Y equals zero if the decision is to keep the rate unchanged and Y equals one (1) if the target rate is raised. In sum, the dependent variable (Y_t) contains all three possibilities of the FOMC rate decision and it also possesses a natural ordering (-1, 0, 1) and thereby can be utilized in the ordered probit modeling. A monthly time series of the FFTR is utilized to create the dependent variable. Two important factors that may affect the FOMC rate decisions are inflation expectations and the unemployment rate. Therefore, we included the PCE deflator and the unemployment rate as predictors of our ordered probit model. The expectations about the overall economy also play a crucial role in the FOMC decision making. A good proxy of the economy, which tends to lead the economic activity, is the index of leading indicators, known as LEI, produced by the Conference Board, is also included in the model. The final model includes the following predictors: the unemployment rate, the PCE deflator (year-over-year percent change) and the LEI (year-over-year percent change). These variables are shown in Figures 1 & 2. [2]

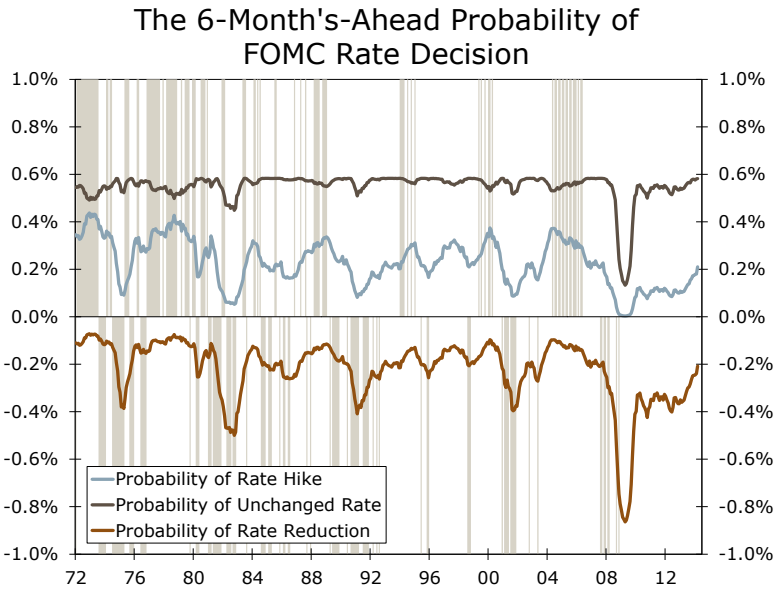
Probabilities of the FOMC Rate Decision Based on the Ordered Probit-Model

The simulated out-of-sample probabilities are plotted in Figure 3. The bars (shaded area) above the zero-line indicate that the FOMC increased its target for the FFTR during those time periods. Similarly, the bars (shaded area) below the zero-line are attached to the periods that experienced

[1] For more detail about the ordered Probit modeling, see the Appendix of this report.
[2] Typically, we face non-stationary issue when we deal with a time series dataset. However, in the present case, our dependent variable is a categorical variable (-1, 0, 1) and two predictors are in growth rates (first difference) and therefore, we do not face non-stationary issues. The unemployment rate tends to behave like a mean-reversion series and that is also known as stationary.

a reduction in the target rate. The blank area, between January 2009 and March 2014, for instance, shows that the FOMC did not change the target rates.

Figure 3



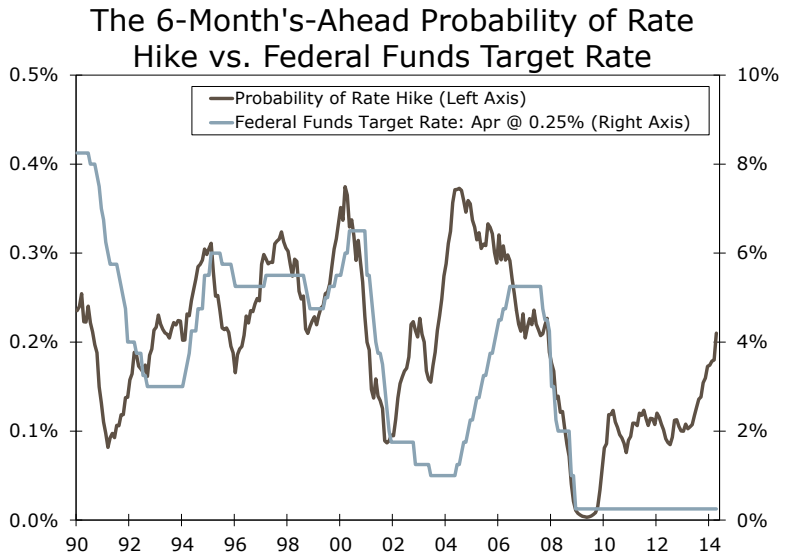
Source: Wells Fargo Securities, LLC

In Figure 3, the brown line represents a six-month's-ahead probability that the FOMC would keep the target rate unchanged, the blue line indicates the probability of a rate hike and the red line represents the probability of a rate reduction. We converted probabilities of rate reduction into a negative series (probabilities multiplied by negative one) and a probability closer to -1 (minus one), the red line, indicates a significant chance of a rate reduction within the next six months. Similarly, a probability closer to 1 (one), the blue line, shows a significantly higher chance of an interest rate hike decision by the FOMC. Finally, if the brown line, probability of unchanged rate decision, is close to one then it indicates a significant chance of no change in the FFTR during the next six months.

Our probability of a target rate hike is very consistent with the actual FOMC's decisions to raise rates.

In Figure 4, we plotted the FFTR (blue line) along with the six-month's-ahead probability of a rate hike. The brown line, the probability of a target rate hike, is very consistent with the actual FOMC's decisions to raise rates. In our simulated out-of-sample period (which starts from January 1990), the first rate hike occurred on February 1994 (the target rate increased 25 bps to 3.25 percent), and, during the next year (between February 1994 and February 1995), the FOMC either raised its target for the FFTR or kept the rate unchanged. The probabilities for the target rate hike followed an upward trending pattern for most of July 1993 (roughly seven months before the first rate hike) through February 1995. The second episode of persistent rate hikes (two or more target rate hikes in six months) occurred during the June 1999-May 2000 period, and the ordered probit model started producing an increasing trended probabilities of rate hikes during October 1998 (around seven months before the first rate hike) and March 2000. The probabilities of raising rates were higher than the probabilities of reducing rates during the September 2003 and September 2006 time period and that is also consistent with the FOMC rate decision behavior as the FOMC followed a contractionary monetary policy between June 2004 and June 2006. The FOMC raised its target for the FFTR during most of the June 2004—June 2006 period. In sum, the ordered probit model consistently predicted the FOMC's decision of a rate hike in our sample period.

Figure 4



Source: IHS Global Insight and Wells Fargo Securities, LLC

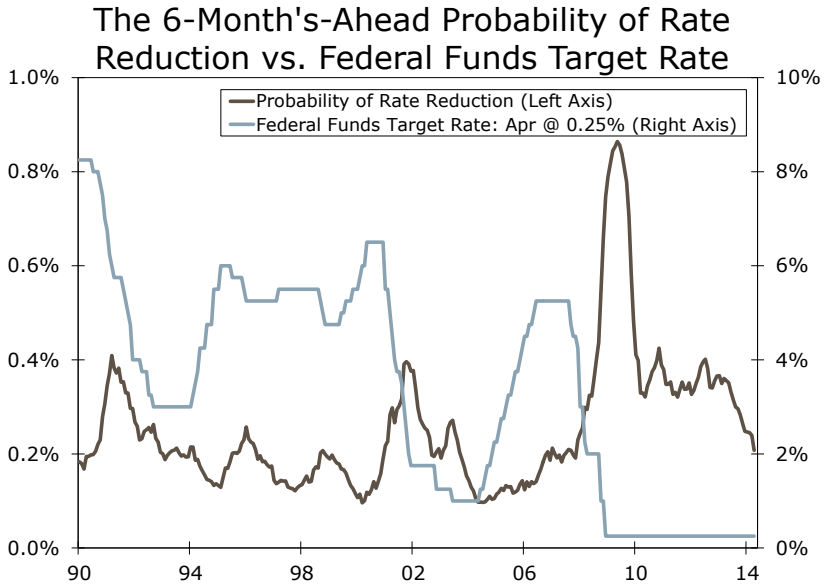
During the June 1990—September 1992 period, the FOMC followed an expansionary monetary policy and reduced the FFTR to 3.0 percent (September 1992) from 8.25 percent (June 1990). Figure 5, the brown line, the six-month's-ahead probability for a rate reduction, started an increasing trend in April 1990 and stayed at an elevated level until September 1992, which is consistent with the decisions to reduce the funds rate by the FOMC for that time period. Furthermore, the model predicted a higher probability of a rate reduction during the December 2000-December 2001 period, and that came to pass as the FOMC reduced the target rate to 1.75 percent (December 2001) from 6.5 percent (December 2000). The August 2007—December 2008 period observed another round of reductions in the target rate; the rate reduced from 5.25 percent (August 2007) to 0.25 percent (December 2008) and the model predicted higher probabilities of the rate reduction starting May 2007. The highest probability was observed on May 2009 (86 percent). The FFTR has been in the 0-0.25 percent range since December 2008, which indicates an expansionary monetary policy and that stance of the monetary policy is matched with relatively higher probabilities of rate reduction produced by the ordered probit model during that time period.

There is a significant chance of a change in the stance of the monetary policy in the near future.

One noticeable observation is that since June 2013, the probability of a rate reduction has been trending downward and based on the April 2014 data the probability is 21 percent, which is the lowest since December 2007. At the same time, the model predicted an upward trending probability of a rate hike since June 2013 and based on the April 2014 data, the probability of a rate hike is 21 percent. This pattern implies that there is a significant chance of a change in the stance of the monetary policy in the near future. In addition, a persistently higher probability for a particular FOMC rate decision scenario is consistent with the 1990s and 2000s episodes when the model predicted a relatively higher probability for an extended period of time for a particular stance of monetary policy and that prediction was matched with the subsequent FOMC rate decisions. That is, the model consistently predicted upward trending probabilities of a target rate hike between the June 2003 and June 2004 period and the FOMC raised its target rate to 1.25 percent on June 2004 from 1.0 percent.

Another observation from the ordered probit model results is that the probabilities of raising rates started moving upward since June 2013, which was a sign that the FOMC might soon begin to change the stance of monetary policy, which it did starting December 2013. That is, in December 2013, the FOMC started rolling back its assets purchase program also known as quantitative easing (QE).

Figure 5



Source: IHS Global Insight and Wells Fargo Securities, LLC

A Consistent FOMC Behavior around Target Rate Decisions

The data indicates a very consistent FOMC behavior about the target rate decisions.

The data indicate a very consistent FOMC behavior about the target rate decisions. That is, during the January 1990—April 2014 period (a total of 292 monthly observations), only 10.3 percent (30 monthly observations) of the total time period was the target rate raised; alternatively, for 14.4 percent (42 observations), the target was reduced. Finally, for 75.3 percent (220 observations) of the time there was no-change in the target rate. The persistence in the rate decision is also captured by our ordered probit model as the probability of no rate change (brown line in Figure 3) is consistently higher than the other two probabilities for most of the 1990-2014 time period. The consistent behavior of the FOMC indicates that once it set a stance of the monetary policy (whether contractionary or expansionary), it follows that path for an extended period of time. Furthermore, actions of the FOMC take time to show an impact on the economic activity (inflation and labor market for instances), and an extended path of a particular stance of monetary policy would help the FOMC to achieve its long-term goals (maximum employment and price stability).

Concluding Remarks

One of the key results of the ordered probit model is that since June 2013, the probability of a rate reduction has been trending downward and based on the April 2014 data the probability is 21 percent, which is the lowest since December 2007. At the same time, the model has predicted the upward probability of a rate hike since June 2013 and the probability of a rate hike is 21 percent, based on the April 2014 data. This pattern suggests that there is a significant chance of a change in the stance of the monetary policy in the near future. That result may also shed light on why the FOMC started to roll back the QE program in December 2013.

Appendix

In the ordered probit modeling, the dependent variable is a latent (unobservable) continuous variable, say Y_t^*, and the conditional mean of Y_t^* is a linear function of explanatory variables (Z_t). Furthermore, a discrete variable, say Y_t, can be generated based upon the Y_t^* values and then Y_t can be utilized as a dependent variable in the ordered probit model. One of the ordered probit modeling conditions is that the dependent variable only contains integers with natural order (for instance, 0, 1, 2,... so on). [3]

The following ordered probit model is built and estimated to generate probabilities of the FOMC rate decisions. We begin by assuming an ordered probit model of the form:

$$Y_{T+h|T}^* = \beta' \ Z_t + \varepsilon_t \qquad (1)$$

where $Y_{T+h|T}^*$ is an unobserved variable that determines, at time *T*, if the FOMC rate decision is; a target rate hike, reduction in the rate or no-change in the target rate within the next *h* periods (in this case *h*=6 because we are interested in 6-month ahead probability). Z_t is a vector of independent variables; β is a vector of coefficients including an intercept; and ε_t is a normally distributed error term. Y_t^* is an unobservable continuous variable and an ordered probit model requires a discrete observable dependent variable for the estimation. Therefore, using the equation (2), a discrete dependent variable, Y_t, is generated.

$$Y_t = -1 \quad \text{if } Y_t^* = r_1$$

$$Y_t = 0 \quad \text{if } Y_t^* = r_2 \qquad (2)$$

$$Y_t = 1 \quad \text{if } Y_t^* = r_3$$

$$Y_{T+h/T} = \beta' \ Z_t + \varepsilon_t \qquad (3)$$

In order to generate Y_t, three parameters, r_1 , r_2 and r_3 are created. Where r_1 = if the target rate was reduced, r_2 = if the target rate was unchanged and r_3 = if the target rate was raised. Furthermore, if $Y_t^* = r_1$ then Y_t= -1, Y_t is equal to zero if $Y_t^* = r_2$ and if $Y_t^* = r_3$ then Y_t=1. Given historical data on the Federal funds target rate, three scenarios (rate hike, reduction in the rate and un-changed rate) are captured in Y_t and with a set of predictor variables represented by Z_t, a six-months-out probability of these three scenarios can be generated by estimating equation (3).

[3] **For more detail see Maddala, G.S. (1983).** ***Limited-Dependent and Qualitative Variables in Econometrics*****. Cambridge University Press, Cambridge, UK**

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