How Farsighted Is the FOMC?

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The most difficult problem facing monetary policymakers results from the long and variable lags in monetary policy's impact on the economy. The full effect of an interest rate change today is not realized for several quarters, so central bankers must be forward-looking. Yet, it is difficult enough to interpret how the economy is doing now, let alone forecast how it will be performing one year hence. This uncertainty hinders the ability of policymakers to offset future fluctuations with current actions. Even so, the lags leave central bankers no choice but to react to their expectations about the future. This article examines the extent to which the Federal Open Market Committee (FOMC) reacts to forward-looking data. It is shown that the FOMC does look into the future, basing its decisions on expectations about the economy at least as far as a year away.

How forward-looking policymakers should be depends both on how long it takes for monetary policy to affect the economy and on the level of uncertainty about the economy's future performance. To estimate the lags associated with monetary policy requires a model of the monetary transmission mechanism. Monetary policy influences the economy through several channels; the relative importance of each channel will help determine how quickly changes in policy affect the economy. Most macro models have a majority of the effect occurring within three to six quarters. How quickly uncertainty escalates as the forecast horizon expands also helps determine how forward-looking the Fed should be. This rising uncertainty, along with uncertainty over when monetary policy takes effect, makes the determination of the optimal horizon more complicated than simply looking ahead three to six quarters. For this reason, this article examines not only the degree to which the FOMC is forward-looking, but also whether the FOMC's forecast horizon depends on the relative uncertainty associated with the different forecast horizons. It finds that the FOMC tends to rely more on the short-term outlook as the long-term forecast becomes relatively more uncertain.

The article begins by describing the data used to examine policy actions. Estimation of the determinants of both the FOMC's policy votes and changes in the federal funds rate is then performed. Both votes and changes in the federal funds rate are shown to depend on current, lagged, and one-quarter-ahead forecasted variables. The analysis is then extended to include horizons out to four quarters ahead. The evidence suggests that the FOMC looks at least one year forward. Finally, the effects of forecast uncertainty on the farsightedness of the FOMC are analyzed. It is found that the FOMC's reaction to the different forecast horizons depends on the relative uncertainty across these horizons, which can change over time. A conclusion follows.

I. The Data

The behavior of the FOMC has been explored in several different ways: by using the minutes of its meetings to capture broad movements in policy direction, as in Romer and Romer (1989); by examining the minutes to capture the exact votes at each meeting, as in Tootell (1991a, 1991b, 1996), Belden (1989), and Chappell, Havrilesky, and McGregor (1993); and by examining the movement of the assumed instrument of Fed policy, as in McNees (1986, 1992), Alesina and Sachs (1988), Havrilesky (1987), and a host of others. The last approach, explaining the movements of either the money supply or the federal funds rate with variables representing the current state of the economy, is the most common.

One major drawback to the reaction function approach is the uncertainty surrounding the FOMC's instrument. If the researcher examines the incorrect instrument, then all subsequent conclusions about the determinants of FOMC behavior are invalid. For this reason, the current study emphasizes analysis of the policy votes of the FOMC. Concerns about studying the wrong instrument are avoided by examining votes, since no matter which instrument is used, the vote captures the FOMC's desire to change that instrument.

Each member's policy vote is found in the minutes of the FOMC meetings. The directive at the end of the minutes describes the policy action taken; it dictates either tighter, looser, or constant policy.[1] All 12 members of the FOMC vote on the policy action taken at each meeting. The desired policy of any vote against the action is clear from the reasons given for the dissent. Thus, at every meeting each member's desired policy move is recorded.

Table 1
Definitions of Variables

L	Lagged growth rate of real GDP
Q1	1-quarter-ahead forecast of real GDP growth in the Green Book
QH1	Forecast of real GDP growth over the next 6 months
QH2	Forecast of real GDP growth over the 6 months starting 6 months from now
LP	Lagged inflation rate (lag of the 3-month growth of core CPI)
P1	1-quarter-ahead forecast of the inflation rate[a] in the Green Book
PH1	Forecast of inflation over the next 6 months
PH2	Forecast of inflation over the 6 months starting 6 months from now
URL	Lag of the civilian unemployment rate
M	Lagged 3-month moving average of M1 growth

[a]The core Consumer Price Index is used back to 1979. Prior to that, change in the implicit price deflator is used.

Both FOMC votes and changes in the federal funds rate are estimated as functions of economic data known at the time of the meeting and of forecasts of the future course of the economy. Before every FOMC meeting the staff at the Federal Reserve Board prepare a detailed outlook for the economy. This forecast and a discussion of its key elements are compiled in a green book, and circulated to every member of the FOMC. (Data in this "Green Book" are made available to the public with a five-year lag.) The forecast is broken down by quarter and goes out one to two years into the future. The projected variables include GNP and its major components, the unemployment rate, and a variety of inflation measures. The forecasts contained in the Green Book do not necessarily represent the views of the FOMC, but they are probably the best available instruments for the expectations of the FOMC members.

Table 1 provides a list of the independent variables used in this study. When examining the forward-looking nature of the FOMC, the quarterly forecasts are combined into six-month intervals in order to smooth out some of the noise inherent in quarterly

[1] All these votes are examined given the state of the economy. Thus, if the economy fell into recession and the FOMC decided to do nothing, the policy may be "tight" relative to how the FOMC behaved in the past, but the action is still a no change.

numbers. Further, only two six-month horizons are included at any one time, since the Green Book did not consistently contain forecasts more than one year out in the early part of the sample. Because the Green Book is available to the public with a five-year lag and it did not include forecasts of many of the important variables before 1965, the sample is restricted to the years 1965 to 1991. The results of the estimation are provided in the next section.

II. Traditional Reaction and Voting Functions

Most previous empirical models of the determinants of monetary policy have modeled Fed behavior as backward-looking. Columns (1) and (4) of Table 2 present the coefficient estimates for voting and reaction functions when only lagged variables are included. The estimated voting function presented in column (1) takes the form

$$P_{Tighten}/P_{No\ Change} = \alpha_1 + \alpha_2 \Delta Q_{t-1} + \alpha_3 \Delta P_{t-1} + \alpha_4 \Delta M_{t-1} + \alpha_5 UR_{t-1} + \epsilon_{T,t} \quad (1)$$

$$P_{Loosen}/P_{No\ Change} = \beta_1 + \beta_2 \Delta Q_{t-1} + \beta_3 \Delta P_{t-1} + \beta_4 \Delta M_{t-1} + \beta_5 UR_{t-1} + \epsilon_{L,t}.$$

In this model, the probability of tightening and loosening relative to maintaining current policy unchanged depends on last quarter's GNP growth, ΔQ_{t-1}; the recent inflation experience, ΔP_{t-1}; the recent growth of the money supply, ΔM_{t-1}; and the level of the unemployment rate, UR_{t-1}.[2] Note that money may be important, independent of last period's nominal GNP growth, because of its potential as an indicator of future inflation or future nominal GNP growth; if so, the inflation and output variables may appear less important than they in fact are.

Since the voting variable is trichotomous—to tighten policy, loosen it, or leave it unchanged—a multinomial logit is estimated. This procedure produces different sets of coefficients for the tighten and the loosen probabilities, as the variables have different effects on the two voting probabilities. The top panel of the table provides the coefficients estimated for the probability of tightening, and the bottom panel provides the coefficient estimates for the probability of loosening.[3]

All the coefficients have the expected signs. The FOMC is more likely to tighten and less likely to loosen policy when the economy is growing rapidly, when inflation is high, when the money supply growth is fast, or when the unemployment rate is low. Only the coefficient on lagged unemployment for loosening is not statistically significant at the 5 percent level. The estimated coefficients in column (1) show that the backward-looking economic variables do have the expected effect on FOMC behavior.

Column (4) of Table 2 presents the coefficients estimated from the more traditional Fed reaction function. The change in the federal funds rate, ΔR_t, depends on the same backward-looking economic variables as in the voting function,

$$\Delta R_t = \alpha_1 + \alpha_2 \Delta Q_{t-1} + \alpha_3 \Delta P_{t-1} + \alpha_4 \Delta M_{t-1} + \alpha_5 UR_{t-1} + \epsilon_t. \quad (2)$$

The variables generally have the expected effect on the change in the federal funds rate. The FOMC tends to increase the federal funds rate when money growth is high, the unemployment rate is low, and output is growing rapidly. Only the coefficient on lagged inflation is not statistically significant beyond the 5 percent level. This result is consistent with previous work on reaction functions; backward-looking real variables tend to be significant, but lags of inflation are not. The insignificance of lagged inflation, however, could be due to the inclusion of lagged money; the FOMC should react to expectations of future inflation, and past money growth may be viewed as a better predictor of future inflation than past inflation.

This brings us to the central point: Since monetary policy affects the economy with a lag, the Fed should be reacting to the expected future values of these variables. Certainly current expectations about the future path of a variable depend on past values of that variable, but forecasts are likely to be better indicators of the variable's future value than its latest realization. Columns (2) and (5) of Table 2 replace the backward-looking data on inflation and output growth with the one-quarter-ahead forecast of the variables from the Green Book. Variants of this specification have ap-

[2] Recent inflation is defined as the increase in the CPI excluding food and energy over the previous three months. M1 growth over the previous three months is the lagged money variable. And the most recent unemployment rate and growth rate of GNP known before the meeting are used.

[3] The model is identified by normalizing the coefficients on a no change vote to zero—the probabilities of both loosening and tightening are estimated relative to the probability of no change.

Table 2
Historic Voting and Reaction Functions

	Logit Estimations of FOMC Voting			Reaction Functions		
	(1) Lagged Data	(2) 1Q Ahead Forecasts	(3) Lagged Data and 1Q Ahead Forecasts	(4) Lagged Data	(5) 1Q Ahead Forecasts	(6) Lagged Data and 1Q Ahead Forecasts
Dependent Variable: Vote for Tightening				Dependent Variable: Change in Fed Funds Rate		
C	−1.22	−1.76	−1.74	−.02	−.12	−.13
	(−6.46)	(−8.62)	(−8.23)	(−.18)	(−.92)	(−1.05)
LQ	.09		.05	.02		.005
	(6.86)		(3.05)	(2.23)		(.52)
Q1		.13	.09		.03	.03
		(7.89)	(3.96)		(3.28)	(2.48)
LP	.09		−.07	.03		.02
	(2.97)		(−1.79)	(1.37)		(.71)
P1		.19	.23		.03	.03
		(8.23)	(7.51)		(2.25)	(1.38)
URL	−.20	−.26	−.24	−.04	−.05	−.05
	(−6.22)	(−8.0)	(−7.33)	(−2.22)	(−2.59)	(−2.64)
M	.10	.11	.10	.02	.02	.02
	(8.39)	(9.61)	(8.56)	(3.13)	(3.45)	(3.33)
Vote for Loosening						
C	−.41	−.005	.18			
	(−2.05)	(−.02)	(.85)			
LQ	−.13		−.11			
	(−8.37)		(−6.42)			
Q1		−.15	−.09			
		(−8.41)	(−4.55)			
LP	−.11		−.01			
	(−3.42)		(−.31)			
P1		−.18	−.21			
		(−6.07)	(−5.62)			
URL	.06	.11	.10			
	(1.68)	(3.36)	(3.08)			
M	−.08	−.10	−.08			
	(−5.66)	(−7.24)	(−6.1)			
Observations	3077	3077	3077	268	268	268
Log-Likelihood	−2745.9	−2710.7	−2678.6	−181.5	−178.3	−177.9

peared in Tootell (1991a, 1991b, and 1996) and McNees (1986 and 1992). Money growth remains lagged because the Green Book does not include money growth forecasts. The unemployment rate also remains lagged in this specification because the forecasted change in GNP and the forecasted change in the unemployment rate are so collinear; given Okun's law, knowing the current unemployment rate and the forecasted change in GNP all but produces the unemployment rate forecast.[4]

All the coefficients in this more forward-looking

[4] Okun's law is, in reality, not a law, but the relationship between GDP growth and changes in the unemployment rate is strong enough to produce serious collinearity between the forecasted change in unemployment and the real GNP growth forecast.

model, presented in columns (2) and (5), are significant and correctly signed. In the voting function, the lagged unemployment rate is now significant in explaining both the probability of voting to tighten policy and the probability of voting to loosen policy. In the reaction function, all the forecasted variables are significant, including that for inflation. Using the expectations of future inflation and growth also significantly increases the explanatory power of both the voting and the reaction functions.

The FOMC is more likely to tighten and less likely to loosen policy when the economy is growing rapidly, when inflation is high, when the money supply growth is fast, or when the unemployment rate is low.

Columns (3) and (6) of Table 2 examine whether the significance of the forecasted variables is due to their collinearity with the backward-looking variables. Both forward- and backward-looking variables are examined. The inflation forecast dominates the lagged inflation variable in both the voting and the reaction functions; the coefficient on lagged inflation is either insignificant or incorrectly signed, while the coefficient on the inflation forecast is always significant and correctly signed. The coefficient on the output forecast also is always correctly signed and statistically significant. Certainly, the inflation forecast dominates the lagged inflation, suggesting that collinearity between lagged and forecasted inflation is not causing the significance of the inflation forecast.

However, in the voting function both the lagged and forecasted growth rates of real GNP are important. The result suggests that the FOMC is both backward- and forward-looking. The apparent rear vision on the part of the FOMC could simply be an artifact of using only the one-quarter-ahead forecast; the near-term forecast may fail to capture all that the FOMC believes is important in determining the future course of the economy. Looking at both the one-quarter-ahead forecast of real GNP growth and its last known value may capture dynamics relevant to policy. In other words, both forward-looking and backward-looking real growth may be significant, because GNP growth over more than a quarter is important.

III. Longer Horizons

Although the voting and reaction functions estimated in columns (2),(3),(5), and (6) of Table 2 are consistent with many in the literature, including those in Tootell (1991a, b and 1996) and McNees (1986, 1992), the one-quarter-ahead forecast alone is not necessarily a good indicator of where the economy is going. This section examines the reaction of the FOMC to forecast horizons that are more relevant to monetary policy; specifically, horizons that are further out and cover more than one quarter are analyzed. The furthest horizon investigated here is one year ahead, since forecasts beyond one year were not always given in the earlier Green Books. Also, since the FOMC does not attempt to affect the economy quarter by quarter but over a longer period, the forecast growth in output and inflation over the first six months following an FOMC meeting and the forecast growth over the subsequent six months are included as explanatory variables.[5] This specification simultaneously examines whether the FOMC looks far in the future and whether it reacts to the general movement of the economy over time rather than reacting to quarterly noise.

The results are presented in Table 3. Columns (1) and (4) repeat the base specification from columns (3) and (6) of Table 2, except that lagged inflation has been omitted.[6] Columns (2) and (5) present the coefficients from a model when the one-quarter-ahead forecasts of real growth and inflation are replaced by forecasts of these variables over six months. Using the forecast of the next six months significantly improves the voting equation's performance. Both the output forecast and the inflation forecast have a larger and more significant effect on FOMC voting when the six-month forecast is included. A likelihood ratio test strongly rejects the probability that the added quarter's forecast should be omitted. The results for the reaction function are qualitatively similar but not as strong. The data clearly indicate that the FOMC looks at least two quarters ahead when formulating policy.

[5] The exact number of months ahead of the date of the meeting varies, depending on how late in the current quarter the forecast is made.

[6] The lagged inflation rate is omitted because it was always insignificant or incorrectly signed. Note also that the number of observations is smaller, since this equation will be compared to equations over the sample where longer-horizon forecasts were available.

Table 3

Voting and Reaction Functions with Longer-Term Horizons

	Logit Estimations of FOMC Voting			Reaction Functions		
	(1) Lagged Data and 1Q Ahead Forecasts	(2) Lagged Data and 2Q Ahead Forecasts	(3) Lagged Data and 1 Year Ahead Forecasts	(4) Lagged Data and 1Q Ahead Forecasts	(5) Lagged Data and 2Q Ahead Forecasts	(6) Lagged Data and 1 Year Ahead Forecasts
Dependent Variable: Vote for Tightening				Dependent Variable: Change in Fed Funds Rate		
C	−1.37	−1.76	−2.07	−.24	−.31	−.37
	(−4.65)	(−5.64)	(−6.26)	(−1.32)	(−1.66)	(−1.94)
LQ	.05	.03	.04	.004	−.002	.004
	(2.62)	(1.41)	(2.04)	(.33)	(−.14)	(.32)
Q1	.06			.03		
	(2.70)			(2.42)		
QH1		.16	.01		.05	.02
		(5.08)	(.38)		(2.78)	(.80)
QH2			.27			.06
			(6.00)			(2.39)
P1	.19			.04		
	(7.37)			(2.31)		
PH1		.28	−.04		.05	.05
		(8.86)	(−.50)		(2.73)	(1.06)
PH2			.47			.02
			(5.26)			(.46)
URL	−.30	−.35	−.49	−.04	−.05	−.07
	(−7.12)	(−7.82)	(−9.09)	(−1.69)	(−1.97)	(−2.75)
M	.11	.11	.10	.03	.03	.03
	(8.37)	(8.52)	(7.90)	(3.48)	(3.48)	(3.54)
Vote for Loosening						
C	.63	.98	1.24			
	(2.28)	(3.36)	(4.14)			
LQ	−.12	−.09	−.07			
	(−7.01)	(−4.82)	(−3.41)			
Q1	−.05					
	(−2.44)					
QH1		−.14	−.17			
		(−4.60)	(−4.84)			
QH2			.07			
			(1.59)			
P1	−.19					
	(−6.04)					
PH1		−.27	.08			
		(−7.06)	(1.08)			
PH2			−.43			
			(−4.81)			
URL	−.001	.03	.02			
	(−.03)	(.83)	(.54)			
M	−.06	−.06	−.08			
	(−4.50)	(−4.61)	(−5.28)			
Observations	2423	2423	2423	212	212	212
Log-Likelihood	−2125.5	−2098.5	−2054.8	−151.6	−150.9	−147.9

Still, monetary policy has little effect on the economy even after two quarters. Columns (3) and (6) present equations that include the forecasts of both the next half year and the subsequent half year. Thus, the effect on monetary policy of forecasts at horizons that are clearly relevant for monetary policy are now estimated.

The evidence suggests that the FOMC does tend to look at forecasts as far as one year forward when determining monetary policy. The voting function indicates that the FOMC is very farsighted when it comes to inflation. The probabilities of tightening and loosening react much more strongly to the out-term inflation forecast than to the forecast of inflation over the next six months; both coefficients on the out-term inflation forecast are statistically significant and correctly signed, while neither of the coefficients on the near-term inflation forecast is significant. The out-term forecast for real output growth also significantly affects the probability that the FOMC will tighten policy. Again, the inclusion of the out-half forecasts improves the predictive power of the equations.[7] Results from the voting function strongly support a conclusion that FOMC members look as far as one year ahead.

Estimates of the reaction function are consistent with these findings. The out-term forecast of output growth dominates the near-term forecast. However, neither the near-term nor the out-term inflation forecast is statistically significant, although if either forecast is included alone, its coefficient is significant and correctly signed. The 0.92 correlation between the two inflation forecasts could explain the apparent insignificance of both inflation horizons in the reaction function. On the other hand, collinearity between the forecast horizons could also explain the significance of the out-term forecasts in the voting function; the out-term inflation forecast may appear important only because it is highly correlated with the near-term outlook.[8] Unless the forecasts vary sufficiently over the different horizons, the estimation results may be an artifact of the forecasting process rather than the product of any true farsightedness. Collinearity should be less of a problem for the real out-term and near-term GNP forecasts because their correlation is much lower, around 0.71.

Table 4 examines the potential effect of the collinearity of the forecasts by analyzing those observations where there is a large difference between the near-term and out-term inflation or output forecasts. The estimation in column (1) allows the coefficients on the two horizons to differ between periods when collinearity between the forecast horizons could be a problem and periods when it should not be a problem. Specifically, a variable equal to one when the inflation forecast changes significantly over the two forecast horizons is interacted with the two inflation forecasts. The same is done with the forecasts of real output. If the out-term forecasts have a larger effect when the differences are large, then collinearity is not the explanation for the significance of the out-term forecasts.

The data clearly indicate that the FOMC looks at least two quarters ahead when formulating policy and suggest that members tend to look at forecasts as far as one year forward.

The results suggest that collinearity is not the explanation for the importance of the out-term output forecasts. The interaction terms on the real output forecasts reveal that for both tightening and loosening, when big divergences occurred in the real growth forecast across the two horizons, the FOMC shifted its attention toward the longer-term forecast horizon. It is these times that provide the correct sign and statistical significance to the coefficients for the out-term output forecasts. In short, when the two output forecasts were less correlated, the FOMC more clearly reacted to the longer-term forecast.

The results for inflation are less clear. The interactive terms suggest that, for the probability of tightening, the correct sign and significance of the long-term inflation forecast occur at times when the two forecasts are similar, not dissimilar. However, for the probability of loosening, the coefficients imply that the farsightedness is no different in cases with large differences in the forecast than in cases where the fore-

[7] The log-likelihood ratio that the coefficients on the out-term forecast horizon for inflation and real growth are zero is 87.5 for the voting function. The log-likelihood ratio is distributed as a χ^2 with 4 degrees of freedom; its critical value is equal to 11.1 at the 5 percent level.

[8] The voting function may be picking up the distinction more effectively because the power of the test is higher with the larger sample size. An alternative explanation is that many of the FOMC dissents, which are not translated into changes in the Fed's instrument, occur because of the long-term inflation forecast.

Table 4
Collinearity of the Forecasts

	Logit Estimations of FOMC Voting			Reaction Functions		
	(1) Large Changes in Forecasts	(2) Large Changes in Output Forecast	(3) Large Changes in Inflation Forecast	(4) Large Changes in Forecasts	(5) Large Changes in Output Forecast	(6) Large Changes in Inflation Forecast
Dependent Variable: Vote for Tightening				Dependent Variable: Change in Fed Funds Rate		
C	−2.40	−10.54	−.08	−.37	−.85	−.97
	(−7.19)	(−5.29)	(−.08)	(−1.98)	(−1.0)	(−1.27)
LQ	.04	−.35	−.10	−.004	−.02	−.04
	(2.02)	(−4.01)	(−2.44)	(−.34)	(−.26)	(−1.38)
QH1	.40	.34	−.10	.10	−.002	−.03
	(6.48)	(2.48)	(−1.27)	(2.82)	(−.02)	(−.51)
QH2	−.16	.60	.30	−.02	.17	.18
	(−2.37)	(4.15)	(2.41)	(−.55)	(1.81)	(2.44)
Added effect of QH1 when forecast change is large	−.59			−.08		
	(−7.76)			(−2.01)		
Added effect of QH2 when forecast change is large	.59			.13		
	(7.65)			(3.14)		
PH1	−.20	1.57	−.02	−.05	.09	−.14
	(−1.58)	(5.08)	(−.11)	(−.72)	(.48)	(−1.09)
PH2	.67	−.53	.16	.12	−.01	.29
	(4.76)	(−2.02)	(.54)	(1.58)	(−.06)	(1.84)
Added effect of PH1 when forecast change is large	.79			.13		
	(2.69)			(1.15)		
Added effect of PH2 when forecast change is large	−1.03			−.13		
	(−2.92)			(−1.00)		
URL	−.46	−.26	−.52	−.07	−.08	−.10
	(−8.77)	(−1.87)	(−4.30)	(−2.69)	(−.69)	(−1.44)
M	.11	.20	.14	.03	.05	.11
	(8.02)	(4.10)	(2.75)	(3.69)	(1.45)	(3.30)
Vote for Loosening						
C	1.81	1.85	2.52			
	(5.41)	(2.05)	(2.16)			
LQ	−.06	−.11	−.11			
	(−3.06)	(−1.58)	(−2.59)			
QH1	−.35	−.08	−.10			
	(−5.58)	(−.75)	(−1.52)			
QH2	.29	−.15	−.37			
	(4.42)	(−1.06)	(−3.82)			
Added effect of QH1 when forecast change is large	.06					
	(.83)					
Added effect of QH2 when forecast change is large	−.35					
	(−5.05)					

casts are similar. Collinearity is not driving the importance of the out-term inflation forecast when estimating the probability of loosening, but when estimating the probability of tightening it appears partially responsible for the importance of the out-term inflation forecast.

Table 4 continued
Collinearity of the Forecasts

	Logit Estimations of FOMC Voting			Reaction Functions		
	(1) Large Changes in Forecasts	(2) Large Changes in Output Forecast	(3) Large Changes in Inflation Forecast	(4) Large Changes in Forecasts	(5) Large Changes in Output Forecast	(6) Large Changes in Inflation Forecast
Vote for Loosening (cont.)						
PH1	−.21	.54	.41			
	(−1.61)	(2.45)	(1.90)			
PH2	−.25	−.88	−.93			
	−(1.90)	(−2.62)	(−3.72)			
Added effect of PH1 when forecast change is large	.10					
	(.48)					
Added effect of PH2 when forecast change is large	.03					
	(.11)					
URL	−.004	−.05	−.03			
	(−.09)	(−.34)	(−.35)			
M	−.08	−.11	.03			
	(−5.49)	(−1.93)	(.76)			
Observations	2423	370	438	212	32	38
Log-Likelihood	−1976.9	−273.4	−363.6	−141.6	−34.0	−28.8

Columns (2) and (3) approach the problem differently. The voting functions are estimated separately over the sample where large differences exist between the near-term and out-term forecasts. Column (2) examines the part of the sample where the forecast of real output growth diverges significantly between the two horizons. Even though the sample size is much smaller, the coefficients on the real output forecast in the out-term are still correctly signed and statistically significant at the 1 percent level for the probability of tightening. The coefficient on the out-term forecast is correctly signed but not significant for the probability of loosening. The out-term is also economically significant, as both the out-term coefficients are larger, absolutely, than the near-term counterparts.

Column (3) presents the coefficients produced when the specification is estimated over the part of the sample with significant differences between the two inflation forecasts. The coefficient on the out-term inflation forecast is significant and correctly signed for the probability of loosening. Thus, there is fairly strong evidence that the importance of the out-term inflation forecast in the full sample is not due simply to its collinearity with the near-term forecast.

The results from the reaction functions are basically the same. The interactive terms in column (4) reveal that the FOMC reacts more strongly to the out-term forecast of output when it is very different from the near-term forecast. No difference is found in the FOMC reaction to the inflation forecast horizon when the near and out-term inflation forecasts differ. Estimates of the reaction function over the subsample where the difference between the two real output forecasts is large, shown in column (5), tend to reinforce the importance of the out-term forecast when the real output forecasts differ, while column (6) reveals the importance of the out-term inflation forecast when the inflation forecasts differ significantly across the two horizons.

The FOMC does appear to be farsighted in making policy. The significance of the out-term forecasts in predicting FOMC behavior is not due simply to the collinearity between the near-term and the out-term projections. The out-term forecasts have the predicted effect on FOMC behavior even when the forecast changes significantly over the two horizons. The effect is seen more clearly for real output growth than for inflation because the inflation forecasts are more

Table 5
Horizon Changes After 1979

Multinomial Logit Estimations of FOMC Voting

	(1) Full Sample	(2) Post-1979	(3) Pre-1979	(4) Full Sample: Horizon Interaction Variables	(5) Full Sample: Interaction Variables for All Variables
Dependent Variable: Vote for Tightening					
C	−2.07	−5.84	−1.31	−2.40	−1.31
	(−6.26)	(−7.94)	(−2.77)	(−6.50)	(−2.77)
Post 1979					−4.53
					(−5.19)
LQ	.04	.04	−.01	.03	−.01
	(2.04)	(1.04)	(−.55)	(1.70)	(−.55)
Added effect of LQ post 1979					.06
					(1.17)
QH1	.01	.06	.07	.01	.07
	(.38)	(.84)	(1.23)	(.30)	(1.23)
QH2	.27	.37	.63	.30	.63
	(6.00)	(4.07)	(6.97)	(4.75)	(6.97)
Added effect of QH1 post 1979				.12	−.004
				(1.71)	(−.04)
Added effect of QH2 post 1979				.16	−.26
				(2.02)	(−2.07)
PH1	−.04	−.23	−.02	−.05	−.02
	(−.50)	(−1.64)	(−.16)	(−.49)	(−.16)
PH2	.47	.72	.96	.63	.96
	(5.26)	(4.54)	(5.90)	(5.19)	(5.90)
Added effect of PH1 post 1979				.18	−.21
				(.96)	(−1.12)
Added effect of PH2 post 1979				−.26	−.24
				(−1.33)	(−1.04)
URL	−.49	.04	−1.40	−.58	−1.40
	(−9.09)	(.54)	(−9.96)	(−8.52)	(−9.96)
Added effect of URL post 1979					1.44
					(8.89)
M	.10	.04	.18	.10	.18
	(7.90)	(2.24)	(5.22)	(7.28)	(5.22)
Added effect of M post 1979					−.14
					(−3.82)

highly collinear. In general, the evidence indicates significant farsightedness on the part of the FOMC.

IV. Constancy over Time

The FOMC appears to be farsighted now, but it was accused of being too nearsighted in the 1960s and 1970s. This section considers just how farsighted the FOMC was in the earlier period.

Determining whether a structural change in the FOMC's behavior occurred is problematic. One approach is to be completely agnostic, allowing the data to uncover any structural break. Alternatively, a prior belief about when a possible break might have occurred can be imposed and its validity tested. Since

Table 5 continued

Horizon Changes After 1979

Multinomial Logit Estimations of FOMC Voting

	(1) Full Sample	(2) Post-1979	(3) Pre-1979	(4) Full Sample: Horizon Interaction Variables	(5) Full Sample: Interaction Variables for All Variables
Vote for Loosening					
C	1.24	5.00	.65	1.43	.65
	(4.14)	(6.05)	(1.79)	(4.63)	(1.79)
Post 1979					4.35
					(4.83)
LQ	−.07	.07	−.09	−.05	−.09
	(−3.41)	(1.49)	(−3.69)	(−2.66)	(−3.69)
Added effect of LQ post 1979					.15
					(2.98)
QH1	−.17	−.57	−.19	−.20	−.19
	(−4.84)	(−6.36)	(−3.75)	(−4.27)	(−3.75)
QH2	.07	−.34	−.24	−.03	−.24
	(1.59)	(−3.66)	(−3.04)	(−.48)	(−3.04)
Added effect of QH1 post 1979				−.10	−.38
				(−1.54)	(−3.75)
Added effect of QH2 post 1979				−.26	−.10
				(−3.59)	(−.80)
PH1	.08	−.05	−.03	.02	−.03
	(1.08)	(−.34)	(−.20)	(.15)	(−.20)
PH2	−.43	−.76	−.82	−.61	−.82
	(−4.81)	(−4.32)	(−4.30)	(−3.63)	(−4.30)
Added effect of PH1 post 1979				−.46	−.02
				(−2.21)	(−.10)
Added effect of PH2 post 1979				.45	.07
				(2.02)	(.26)
URL	.02	−.05	.71	.28	.71
	(.54)	(−.67)	(6.35)	(4.75)	(6.35)
Added effect of URL post 1979					−.77
					(−5.52)
M	−.08	−.05	−.04	−.07	−.04
	(−5.28)	(−2.43)	(−.95)	(−4.36)	(−.95)
Added effect of M post 1979					−.01
					(−.23)
Observations	2423	1125	1298	2423	2423
Log-Likelihood	−2054.8	−877.2	−1040.4	−2010.3	−1917.6

the behavior of the FOMC has a potentially clear breaking point, when it changed its operating procedures in October of 1979, this paper takes the latter approach. This date has the added benefit of splitting the sample roughly in half.

The first three columns of Table 5 examine the stability of all the coefficients across the two subsamples. Because splitting the sample decreased the number of observations for each estimation, only the results of the voting functions are shown; however,

the reaction function produces similar findings. The first column provides the coefficients from the base regression over the entire sample, while the second and third columns present the coefficients from separate regressions over the pre- and post-1979 periods. A simple log-likelihood ratio test rejects the hypothesis that the two groups of coefficients are identical across the two periods.[9] Some element, or elements, of FOMC behavior appear to have changed.

All in all, the evidence does not suggest that the FOMC was any less forward-looking in the pre-1979 period.

Such a broad test does not, however, reveal the nature of the change. The FOMC may have become more farsighted, or it could have decided to care more or less about a particular variable in the voting function. Column (4) examines the first hypothesis. The coefficients are presented from a regression that covers the entire sample but allows the coefficients on the out- and near-term horizon variables to differ between the two periods. If the FOMC became more forward-looking after 1979, then the coefficients on the out-term forecasts will be statistically significant and of the sign that the variable in general should be.[10]

The coefficients measuring the added effect on FOMC voting of the near- and out-term forecasts of real output growth since 1979 do suggest that the FOMC became slightly more forward-looking after 1979. The effect of the out-term forecast horizon for real GNP growth on FOMC voting, for both tightening and loosening, increases significantly in the second half of the sample. The coefficients for the inflation forecasts tell a slightly different story. Although the evidence suggests that the FOMC approached the inflation forecasts the same way throughout the sample when deciding to tighten, it became slightly less forward-looking about inflation when deciding to loosen. Thus, the evidence is not clear about whether the FOMC became more forward-looking, in general, after 1979.

The way the FOMC reacted to some of the backward-looking variables may also have changed across the two periods. The final column in Table 4 allows all the coefficients to differ in the post-1979 sample. The evidence no longer supports more farsighted behavior in the later part of the sample. In fact, the FOMC appears to have become, if anything, slightly less forward-looking when reacting to real output. The coefficients in column (5) show no evidence of a change in farsightedness when dealing with inflation. In contrast, the FOMC has reacted far differently to the unemployment rate in the post-1979 era. The total effect of the unemployment rate on FOMC voting after 1979 is the sum of the coefficient on the unemployment rate and the coefficient on the added effect of the unemployment rate after 1979, and together the coefficient estimates provide strong evidence that the unemployment rate has become much less important since 1979. The reduced influence of the unemployment rate could, for example, be due to less certainty about what unemployment rate to target or to a greater concern for deviations from trend growth in GNP. All in all, however, the evidence does not suggest that the FOMC was any less forward-looking in the pre-1979 period.

V. The FOMC's Reaction to Forecast Uncertainty

The relative importance of these different forecast horizons should depend on two key factors. First, the effectiveness of monetary policy over those different horizons is important. The faster (more slowly) monetary policy affects the economy, the more (less) important the near-term forecast will be. Second, the relative uncertainty surrounding the different forecast horizons should affect the way the FOMC reacts to them. One would expect uncertainty about the out-term forecast to be greater than the uncertainty surrounding the near-term forecast. And, in fact, comparing the accuracy of the forecasts supports this hypothesis; the root mean squared error is roughly 20 percent lower for the near-term forecast of output growth over the sample examined in this paper. The higher the mean uncertainty surrounding the out-term forecast relative to the near-term forecast, the more the FOMC should, in general, react to the near-term forecast. This section attempts to examine the effects of this uncertainty.

[9] The log-likelihood ratio is 274, far greater than the critical value of the χ^2 with 16 degrees of freedom of 28.8.

[10] Note that adding the coefficient for a given variable estimated over the whole sample to the coefficient for the added effect of that given variable over the post-1979 sample provides the total post-1979 effect of that variable.

An increase in the absolute level of uncertainty across both near and far horizons should have a different effect on the FOMC than an increase in the relative uncertainty between the two different horizons. The more uncertain the FOMC is about both forecast horizons, the less it will react to either. Rising uncertainty about the entire forecast will tend to increase the chances that the FOMC does nothing; when the signal-to-noise ratio rises, the FOMC responds less strongly. On the other hand, when the relative level of uncertainty between the two horizons rises or falls, the FOMC should react to the more certain forecast. If, for example, the FOMC became more uncertain about its long-term forecast without increasing the uncertainty about its near-term outlook, then the optimal response would be to rely more heavily on the near-term forecast. Thus, the relative reaction to the two horizons should depend on the current profile of forecast uncertainty.

Finding a good measure of either type of forecast uncertainty is difficult. Board staff rarely provide a quantifiable measure of the uncertainty of the forecast, let alone the uncertainty surrounding various horizons of the forecast; thus, an alternative source for this measure must be found. The Survey of Professional Forecasters (SPF), collected by the Federal Reserve Bank of Philadelphia, is the best candidate. This survey asks a sample of forecasters for their best guess of inflation and real output growth for the current and the next calendar years and for the odds they associate with specific deviations around these forecasts. The higher the probability the forecasters assign to the economy deviating significantly from their best guess, the higher is the uncertainty surrounding the forecast. The survey is conducted once a quarter. A more complete discussion of the survey can be found in McNees (1994) and Croushore (1993).

Specifically, the forecast uncertainty is calculated by aggregating the surveyed forecasters' stated probability distributions for inflation and real growth. The standard deviation of this aggregate distribution is then used as the measure of uncertainty. McNees (1994) shows that this aggregate distribution accurately captures the actual probability distribution and is, thus, a good measure for the uncertainty surrounding the forecast.

The way the SPF is collected presents several problems with using this measure of uncertainty for this study, however. First, the FOMC meets, and the Green Book forecasts are prepared, more frequently than the SPF is conducted. The votes and the Green Book forecasts occur monthly until 1980 and every six weeks since, while the uncertainty measure from the SPF changes only once a quarter. To accommodate these different frequencies, the last known measure of the uncertainty level is repeated through the quarter.[11]

Several other problems arise from the lack of coincidence between the horizons covered by the Green Book forecasts and the periods encompassed by the SPF uncertainty measures. Obviously, the calendar year uncertainty measures do not line up exactly with the Green Book forecast horizons; not much can be done about this problem, although some different approaches will be examined here. Not so obvious is the fact that the current-year forecast uncertainty from the SPF will depend both on the general level of uncertainty and on how late in the year the survey occurs. As the survey date gets later in the year, the current-year forecast will include known values for inflation and output from the earlier part of the current year; thus, measured uncertainty should, and does, decline as the year progresses. The uncertainty measure, therefore, must be standardized for the time of year. The standardization is performed here by calculating the average uncertainty level for both the current and the out-year's forecasts across the years examined, given the quarter in which the survey was conducted. The deviation of the uncertainty measure from its mean level for all the surveys conducted at the same time of the year is used in this study. This measure of relative uncertainty should take account of the differences in knowledge across the course of the year.

The more uncertain the FOMC is about both forecast horizons, the less it will react to either.

Finally, the length of the survey sample is also problematic. The constructed uncertainty measures for both the current and out-year forecasts of inflation and real GNP growth go back to 1981. The uncertainty

[11] Alternatively, it could be assumed that the change in uncertainty between the two quarters occurs at a constant rate. However, the information that seems to affect this measure could be highly discontinuous. For example, the SPF takes place after the previous quarter's GNP has been released. The importance of this one report may make it wise to change the value only after the report has been issued and, thus, repeat the values.

Table 6
Effects of Horizons with Uncertainty

	Horizon Change with Only Price Uncertainty		Horizon Change with Greater Uncertainty in Longer Horizon	
	(1) Voting Function on 1974–91 Sample	(2) Inflation Uncertainty Added to Voting Function	(3) Inflation Uncertainty and Forecast Horizon	(4) Inflation and Output Uncertainty
Dependent Variable: Vote for Tightening				
C	−2.05	−2.10	−2.14	−13.0
	(−4.21)	(−4.32)	(−4.39)	(−7.68)
LQ	.08	.07	.08	.30
	(3.42)	(3.22)	(3.37)	(5.33)
QH1	−.12	−.11	−.11	−.37
	(−2.73)	(−2.48)	(−2.62)	(−3.50)
QH2	.31	.29	.30	.60
	(6.07)	(5.29)	(5.86)	(3.53)
PH1	.04	.02	.05	−1.13
	(.52)	(.30)	(.52)	(−3.37)
PH2	.32	.34	.32	2.58
	(3.23)	(3.40)	(2.84)	(6.02)
Added effect of PH1 when inflation uncertainty is high			−.10	
			(−.40)	
Added effect of PH2 when inflation uncertainty is high			.10	
			(.38)	
Inflation Uncertainty		−.30		
		(−1.15)		
Added effect of QH1 when 2nd half output uncertainty relatively high				1.21
				(5.03)
Added effect of QH2 when 2nd half output uncertainty relatively high				.30
				(.19)
Added effect of PH1 when 2nd half inflation uncertainty relatively high				2.37
				(4.44)
Added effect of PH2 when 2nd half inflation uncertainty relatively high				−2.40
				(−4.38)
URL	−.38	−.36	−.37	.40
	(−5.98)	(−5.60)	(−5.76)	(3.18)
M	.07	.07	.07	.002
	(5.26)	(5.17)	(5.23)	(.08)

measure for the current-year inflation forecast goes back to 1974. Since Green Book data can be used only before 1992, examining both the real output uncertainty and the inflation uncertainty for the current and out-year forecasts would result in a sample covering only 11 years. For that reason, analysis of the effects of uncertainty on FOMC behavior begins by examining only the uncertainty around the current-year inflation forecast.

The first column of Table 6 presents the coefficients from the basic voting function estimated over the 1974–91 period. The signs and sizes of these coefficients are similar to those found for the full sample, with similar evidence of forward-looking be-

Table 6 continued

Effects of Horizons with Uncertainty

	Horizon Change with Only Price Uncertainty		Horizon Change with Greater Uncertainty in Longer Horizon	
	(1) Voting Function on 1974–91 Sample	(2) Inflation Uncertainty Added to Voting Function	(3) Inflation Uncertainty and Forecast Horizon	(4) Inflation and Output Uncertainty
Dependent Variable: Vote for Loosening				
C	2.05	1.52	1.38	.90
	(3.97)	(2.90)	(2.58)	(.83)
LQ	−.10	−.11	−.11	.08
	(−4.06)	(−4.50)	(−4.23)	(1.36)
QH1	−.19	−.17	−.20	−.84
	(−4.56)	(−4.04)	(−4.64)	(−7.92)
QH2	−.08	−.13	−.11	−.53
	(−1.35)	(−2.20)	(−1.73)	(−3.54)
PH1	.10	.04	−.07	−1.67
	(1.19)	(.44)	(−.73)	(−6.15)
PH2	−.53	−.44	−.28	1.10
	(−4.82)	(−4.06)	(−2.14)	(3.75)
Added effect of PH1 when inflation uncertainty is high			.30	
			(1.12)	
Added effect of PH2 when inflation uncertainty is high			−.46	
			(−1.64)	
Inflation Uncertainty		−1.41		
		(−4.51)		
Added effect of QH1 when 2nd half output uncertainty relatively high				−.86
				(−1.69)
Added effect of QH2 when 2nd half output uncertainty relatively high				−.87
				(−2.73)
Added effect of PH1 when 2nd half inflation uncertainty relatively high				−.97
				(−2.04)
Added effect of PH2 when 2nd half inflation uncertainty relatively high				.86
				(1.83)
URL	.01	.10	.09	.58
	(.11)	(1.75)	(1.38)	(5.05)
M	−.07	−.07	−.08	−.07
	(−4.25)	(−4.45)	(−4.53)	(−3.18)
Observations	1901	1901	1901	949
Log Likelihood	−1538.3	−1527.8	−1528.5	−665.9

havior. Column (2) adds the measure of inflation uncertainty to the basic voting function. As the level of uncertainty rises, the probability of no change in monetary policy increases. The coefficients on the uncertainty measure are negative for both the probability of tightening and the probability of loosening relative to no change, revealing that as uncertainty about the inflation forecast in general rises, the FOMC is more apt to vote for no change.

Increased uncertainty may also affect the forecast horizon to which the FOMC reacts. The third column of Table 6 presents the results of a regression which

adds interactive terms that allow the coefficients on the two inflation horizon variables to differ when inflation uncertainty is high.[12] It appears that added uncertainty about the inflation forecast, whether the uncertainty measure is included independently or not, does not alter the horizons to which the FOMC reacts. The coefficients on the interactive variables are insignificant for both the probability of tightening and the probability of loosening. This finding makes sense, because it is not clear over which part of the forecast horizon the added uncertainty is occurring.

In an attempt to quantify the timing of uncertainty, the relative uncertainty in next year's inflation forecast is compared to the uncertainty in this year's forecast. Since a measure of the out-year forecast uncertainty is now required, the sample must be shortened to the 1981–91 period. When the out-year's forecast is relatively uncertain compared to the near-term forecast, it is assumed that the uncertainty is taking place disproportionately in the out-term of the Green Book forecast.[13] In this case, the near-term forecast in the voting function should be more important than the far-term forecast. Although not a perfect measure of relative uncertainty, the comparison is a good instrument for specifying which half of the forecast is relatively more uncertain.[14] A variable measuring the relative uncertainty of real output is also included, in order to examine the effect of increased relative uncertainty on the FOMC's reaction to the real output horizons.

Column (4) of Table 6 allows the coefficients for each forecast horizon, for both inflation and real output growth, to differ when the long-term forecast is more uncertain. For example, the total effect on FOMC voting of the near-term inflation forecast, when the out-term inflation forecast is relatively more uncertain, is the sum of the coefficients of the near-term inflation forecast and the coefficient on the interactive term. For tightening, the coefficients for both inflation and output suggest that the FOMC reduces its horizon to the near term when inflation or output uncertainty is relatively higher in the out-year. The coefficients suggest stronger reactions to the near-term forecast relative to the long-term forecast when relative uncertainty is high in the out term. For loosening, the evidence also suggests that the FOMC tends to react to the near-term inflation forecasts more strongly as uncertainty rises in the later part of the forecast. For output growth, however, the opposite occurs for the probability of loosening; the FOMC becomes more likely to react to the out-term forecast when output growth uncertainty is relatively higher in the out term. Yet, in general, the results support the idea that the FOMC twists its reaction toward the near-term forecast when relative uncertainty rises on the out-term horizon.

[12] Inflation uncertainty is defined as high when the standardized, de-meaned, measure is one standard deviation above zero.

[13] A high measure of relative uncertainty, defined as a high measure of the de-meaned level of uncertainty in the out-year forecast over that in the near-term forecast, contains about one-fifth of the sample.

[14] A more complete measure of relative uncertainty was examined with no different effect. In this measure, the uncertainty ascribed to the out-half forecast was a weighted average of the current and out-year uncertainty estimates, where the weights depended on the month when the FOMC meeting took place.

Uncertainty around the forecasts, and not just the forecasts themselves, affects monetary policy. Policymakers become more reluctant to act when uncertainty is high.

This finding suggests that uncertainty around the forecasts, and not just the forecasts themselves, affects monetary policy. Furthermore, this influence is of the expected direction. Monetary policymakers become more reluctant to act when uncertainty is high, and the horizon upon which they base their decisions depends upon the relative uncertainty surrounding the different forecast horizons.

VI. Conclusion

The lags in the effects of monetary policy require the Fed to be forward-looking. The evidence presented here suggests that the FOMC does, in fact, react to expectations about the economy. The more forward-looking the policy, however, the more subject policy is to uncertainty around the forecast. This study also shows that the FOMC's reaction to uncertainty appears to be consistent with optimal behavior. As confidence in the out-term forecast increases, the FOMC is more willing to look ahead when setting policy. Thus, the FOMC reacts to the distribution around its forecast, as well as to the forecast itself.

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