

I. INTRODUCTION

In a recent article (1997) we presented estimates of Federal Reserve reaction functions including variables representing economic and political influences.¹ Our goal was to examine the relative importance of political versus economic influences in determining Federal Reserve actions, as well as to see which economic state variables influenced Federal Reserve actions during various time periods.²

This paper extends our earlier work in three ways. First, we re-estimate the monetary policy reaction functions in our earlier study in a way which obviates possible reverse causation problems and better approximates the information set that was available to the Open Market Committee at the time its decisions were made. Second, we now have five more years of data which allow us to examine the Greenspan years more fully; this takes us through 1994, the most recent year for which the Fed's Green Book forecasts are available, given the five-year lag in their release. Third, we divide our sample period, 1965-1994, into two sub-periods, pre-1979 and post-1979, to examine the view that the Federal Reserve evidenced greater concern for inflation in the latter sub-period.³

Section II describes our re-specification of the reaction function. Section III presents new estimates for the whole period, sub-periods broken down by Chairman's regime, and the pre-1979 and post-1979 sub-periods. Section IV compares these estimates with those of our previous paper. Section V contains concluding comments.

¹ Our earlier research was joint with Thomas Havrilesky. Professor Havrilesky passed away on September 9, 1995.

² See Mayer (1990) and Havrilesky (1995) for extensive bibliographies of research into the political economy of monetary policy. Abrams, Froyen and Waud (1980) and Khoury (1990) survey studies which focus on economic influences on Federal Reserve actions.

³ See, e.g., Clarida, Gali and Gertler (2000) and Gertler (1996).

II RESPECIFYING THE REACTION FUNCTION

The monetary policy reaction functions in our previous study were of the following form:

$$(1) \quad f_t = A'X_t^* + B'PI_t + cf_{t-1} + \epsilon_t$$

where f is federal fund rate, X_t^* is a vector of forecasts of economic state variables, PI_t is a vector of measures of political influences, A and B are vectors of coefficients, and ϵ_t is a disturbance term.

In this study we retain the basic form of the reaction function (1) but change the interval over which we measure the data.

Our earlier study used monthly data in the conventional sense -- that is, data measured over calendar months. While this is standard practice, there are reasons to believe it may lead to problems of reverse causation when estimating reaction functions such as (1).

The potential difficulties arise because Federal Open Market committee meeting (FOMC) dates do not typically occur on the first or last day of the month, but rather on an intra-month day. The monthly federal funds rate used in our earlier study was an average of the daily fed funds rates over the month. The forecasted state variables were taken to be the Fed's internally generated Green Book forecasts of the inflation rate, unemployment rate, and the rate of growth of real GNP, or alternatively, "consistent" forecasts of these variables from estimated forecasting equations. Here we will use only the Green Book forecasts, though the problems described are common to both. The measure of political pressure employed was the SAFER index, developed by Havrilesky (1995), a measure of executive branch desires for monetary policy.⁴

⁴ For a description of both forecasting procedures and the SAFER index see our earlier study (1997), pp. 473-476. For a more detailed description of the construction of the SAFER, as well as the rationale for its role as a measure of political influences on Fed policy, see Havrilesky (1995). In an earlier version of this paper and in our earlier work with Havrilesky we

The potential reverse causation problem in our (1997) study arises because Green Book forecasts are as of a given FOMC meeting date. A monthly series was created as a weighted average of these meeting date forecasts. For example, if the FOMC met on 11/15/85 and 12/15/85, the monthly 12/85 observations on the state variables X in (1) – the Green Book forecasts for the inflation rate, unemployment rate, and real GNP growth rate – were constructed as a weighted average equal 0.5 times each meeting date’s forecast, the assumption being that the operative forecast for each variable up until the 12/15/85 FOMC meeting was that of the 11/15/85 meeting, while that of the 12/15/85 meeting was the operative forecast for the rest of December. Since the monthly fed funds rate, the dependent variable f in (1), was constructed as an average of the daily fed funds rates in 12/85, there is the possibility that the fed funds rate for the first two weeks of 12/85 had an effect on the Green Book forecasts for 12/15/85, thus giving rise to reverse causation from f to X in (1) and biased coefficient estimates and inferences. Similarly, since the monthly SAFER index was constructed as the sum of executive branch signals occurring throughout the month, there is the possibility that daily fed funds rates early in the month precede and thereby affect subsequent signals in the month so there is reverse causation from f to PI in (1).

To circumvent these problems, here we take each observation to be an FOMC meeting date so that the measurement interval is that between meeting dates rather than that of a calendar month. Hence the federal funds rate f is now measured as the average of the daily fed funds rate from one FOMC meeting date to the next. In terms of the above example, the dependent variable f in (1) would be the average daily funds rate over the interval from 11/15/85 to 12/15/85, while the state variables X would be the Green Book forecasts of these variables over the next quarter as of the

also employed what he termed a “threat augmented” SAFER which interacted a measure of congressional signaling to the FED with the SAFER measure of executive signaling. We did not find that use of this alternative measure had a significant effect on our results. For a description of the construction of the “threat augmented safer,” see Havrilesky (1995).

11/15/85 FOMC meeting. Thus the policy actions setting the fed funds rate are based only on information (that conditioned the forecasts) which precedes the rate setting. Similarly, the SAFER index, the measure of political pressure on the Fed, is now taken to be the sum of the index over the interval since the prior meeting date up to the 11/15/85 meeting. This assures that policy actions setting the funds rate f are affected only by SAFER signals, PI in (1), that precede f .

Finally, problems of reverse causation aside, using meeting dates to define our measurement interval has the advantage of aligning the Fed's decision more accurately with the actual information available. Responses to forecasts of economic state variables reflect decisions in response to forecasts at the meeting date rather than average responses to the average of forecasts for the month.⁵

III REACTION FUNCTION ESTIMATES

A. Whole Period

In this section we present reaction functions for the period (1965-94) and various sub-periods. Reaction functions presented in the Tables add a second lag on the federal funds rate to correct for autocorrelation in the residuals of equation (1) and are thus of the form⁶

$$(2) \quad f_t = A'X_t^* + B'PI_t + cf_{t-1} + df_{t-2} + \epsilon_t$$

Estimates of equation 2 for the whole period (1/11/66 - 5/17/94)⁷ are shown in the first two lines of Table 1. The forecasted economic state variables (X^*) are the one-quarter ahead Green Book

⁵The procedure here is thus in line with the approaches in recent papers by Ophanides (1998) and Lapp et. al., (2000) which estimate reaction functions on the basis of "real-time" data.

⁶ In our earlier study we corrected for first-order autocorrelation using Hatanaka's instrumental variable procedure. Here we have simply added a second value of the funds rate which appears to eliminate first-order autocorrelation.

⁷ The two 1965 observations are lost due to the two lags on the funds rate.

forecasts of the unemployment rate (U^*) inflation rate (P^*) and rate of growth in GNP (Y^*).⁸ The regression in the first line also includes the SAFER index (S). For the regression in the second line, the SAFER index is divided into signals for easier monetary policy (S_E) and for more tightness (S_T).⁹

The results indicate that over the whole period inflation was the only economic variable for which there was a significant response of the federal funds rate.¹⁰ There does seem to have been a significant response to executive branch signaling (SAFER). When SAFER is divided into ease and tightness signals (line 2) it is the index of signals for tightness that is significant.

B. PRE- and POST-1979

Lines 3-6 of Table 1 show estimates of the same regressions as in the first two lines of the Table when we split the time-period into pre-and post-October 6, 1979.

For the pre-1979 period 1/11/66-9/18/79, the third and fourth rows of Table 1, U^* and P^* are significant while Y^* is not, nor are SAFER or SAFER split into ease and tightness. For the post-1979 period 10/6/79 - 5/17/94, the fifth and sixth rows of Table 1, P^* is again significant, but now Y^* is significant (at the 10% level) and U^* is not. SAFER and SAFER tightness have modest significance levels of roughly 14% and 16% respectively.

The size of the estimated coefficients on P^* are nearly four times larger in the post-1979 period than in the pre-1979 period. The estimated long-run equilibrium response \hat{m} of the Fed funds

⁸ A one-quarter ahead horizon is also used by Clarida, Gali and Gertler (2000) in their baseline model, as was done in our earlier study (1997). They also consider longer more realistic time-horizons. Longer time-horizons are also indicated by Tootell's (1997) study. In our earlier study we also estimated reaction functions using the average of one-and two quarter ahead forecasts for sub-periods where the two-quarter ahead Green Book forecasts were available. This did not significantly change our results (Table 4 versus 5 in (1997)). For the Greenspan sub-period complete series of forecasts for 4 quarters out are available and we use these in the next subsection.

⁹To interpret the signs on SAFER (S), as well as S_E and S_T , note that SAFER is the simple sum of signals for ease, coded +1, and signals for tightness, coded -1, over the intra-meeting interval. S_E and S_T are simple sums of ease (+1's) and tightness (-1's) signals respectively. Thus, the "correct" sign on all three variables is negative.

¹⁰ Unless otherwise noted, the term significant refers to a 5% level.

rate to the Green Book forecast of the inflation rate P^* is given by

$$\hat{m} = [\hat{a} / (1 - \hat{c} - \hat{d})]$$

where \hat{a} is the estimated coefficient on P^* and \hat{c} and \hat{d} are the estimated coefficients on f_{-1} and f_{-2} , the Fed funds rate lagged once and twice respectively. For the pre-1979 period the coefficient estimates in the third row of Table 1 give $\hat{m} = 1.03$ while those in the fourth row give $\hat{m} = 1.02$. This suggests that in the pre-1979 period the Fed (eventually) raised the nominal Fed funds rate an amount just about equal to any increase in the Fed's Green Book forecast of the inflation rate, thus leaving the real Fed funds rate unchanged. For the post-1979 period the coefficient estimates in the fifth and sixth rows of Table 1 give $\hat{m} = 1.62$ and 1.55 respectively, suggesting that the Fed raised the nominal Fed funds rate by over fifty percent more than any increase in the Green Book forecast of the inflation rate, thereby increasing the real Fed funds rate an amount equal more than half the Fed's forecasted (expected) increase in the inflation rate. These estimates support the results in Clarida, Gali and Gertler (2000) who also find that the Fed took a much more aggressive stance against inflation after 1979.

The estimates in lines 3 and 4 show a significant monetary policy response to unemployment in the pre-1979 period. Those in lines 5-6 show a significant response to real GNP growth in the post-1979 period (though only at the 10% level of significance). These results support the view that the Fed did have an employment or output goal throughout the period. In neither the pre-nor post-1979 period was there pure inflation targeting.

C. The Greenspan Period

Table 2 shows estimates for the Greenspan chairmanship for the period 8/87 - 5/94. As previously noted, 1994 is the most recent year for which Green Book forecasts are available given the five-year lag required for their release. Our earlier study reported results only for the rather

limited sub-period 8/87 - 12/89 of the Greenspan years.

results in lines 1 and 2 of Table 2 indicate that only the coefficient estimates for unemployment earlier study. Neither SAFER nor SAFER split into ease and tightness signals was significant here or in our earlier study. The Fed does not appear to have been significantly branch pressures during the Greenspan regime up through 1994.

As state variables for four quarters ahead are available. Line 3 of Table 2 shows a regression of the forecasts for the four-quarter horizon. The regression also includes more realistic targeting horizon, the significant influences on Fed policy are the unemployment rate

It is surprising, given that the estimates in Table 1 show an increased Fed concern for in Table 2 the coefficient on the inflation target is not significant. A problem noted have sufficient variation in inflation and output in order to identify the slope coefficients in the policy function.” Perhaps there is insufficient variation in inflation to identify a Fed inflation response when our reaction function is estimated for the Greenspan period alone?

Our estimates in Table 2 do not, however, necessarily indicate an overall neglect of inflation a goal variable in the Greenspan period. The positive and significant response of the federal funds rate

During the portion of Greenspan’s chairmanship for which we have Green Book forecasts,, the annual inflation

inflation, what in the press is termed a pre-emptive anti-inflationary strike.

D. Other Chairmen's Regimes

Table 3 shows reaction function estimates for the other Fed chairmen's regimes that were examined in our previous paper.¹²

The first two regressions in the Table (line 1) are for a truncated version of the Martin period (1/11/66 - 1/13/70) where the starting date is constrained by the availability of Green Book forecasts. The estimates show significant response of the federal funds rate (of the correct sign) to the unemployment and inflation (at the 10% level) forecasts but not to the forecast of GNP growth. Neither the SAFER index or SAFER split into ease and tightness signals is significant.

The next two regressions in the table (line 2) are for the chairmanship of Arthur Burns (2/10/70 - 1/17/78).¹³ As for the Martin period and the whole pre-1979 period in Table 1, the unemployment and inflation forecasts are significant while the real GNP forecast is not. In contrast to those other estimates, there is a significant response to SAFER, but only of the 10% level. When SAFER is split into ease and tightness signals, tightness signals are not significant while ease signals are significant at only the 11% level.

The fifth and sixth regressions in the table (line 3), show the reaction function for the Volcker period post-September 1979 (10/6/79 - 7/7/87).¹⁴

¹² Hakes (1990) presents evidence that there were significant breaks in reaction functions between Martin and Burns and then Burns and Volcker. Clarida, Gali and Gertler (2000) do not find major significant differences between the Martin and Burns (plus Miller) periods or between the Volcker and Greenspan periods; thus they focus on pre-and post- 1979.

¹³ In our earlier study we add the period when G. William Miller was Fed chairman to the Burns period. Here we have simply dropped the Miller period.

¹⁴ Volcker's actual tenure began in July. We begin this sub-period with October 6 because that date clearly marks a shift in Fed policy, as shown by Clarida, Gali and Gertler (2000).

the Volcker period, only the inflation target has a significant effect on the federal funds rate.

significance level of .129. When SAFER is split into ease and tightness signals neither variable is

The regressions in the last two lines of Table 3 separate out what is sometimes called the sub-period of Volcker's tenure (10/6/79 - 8/24/82). When SAFER is entered as one variable,

the measure of signals for ease is significant. In this regression the forecast of GNP growth is also

It should be noted, however, that the monetarist period is a very short sample period (25 observations).¹⁵

IV OUR EARLIER RESULTS

does the re-specification of the reaction function here cause our results to differ from uses Greenbook forecasts of economic state variables alternatively, "consistent" forecasts of these variables from estimated forecasting equations. The direct comparisons are with our earlier reaction function estimates using Greenbook forecasts Table 4). Comparisons can be made for the whole period and for the chairmanships of Martin, and Volcker. We divide our comparisons into the effects of the SAFER index and those of state variables. These differences between our current (RD) and earlier (JM) estimates are

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also targeting monetary aggregates. When we estimated reaction functions where deviations of growth rates in M1 or M2 were an additional regressor our results did not change significantly. For the monetarist period, for example, while the deviation of details of these additional regressions, see Froyen and Waud (1996). We are grateful to Stephen McNees of the Federal Reserve Bank of Boston for suggesting that SAFER may have been proxying for independent effects of deviations of money (See Hakes and Gamber (1992))

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however, point out above that there were no changes in the variables that were significant in the two sets of regressions.

summarized in Table 4.

A. Political Signaling (SAFER)

In our revised estimates, as in our earlier study, SAFER is significant for the whole period and when SAFER is divided into ease or tightness signals for that period, the measure of signals for tightness is significant. The measure of signals for ease is not significant in the revised estimates while it was in those in our earlier paper.¹⁷

Looking at sub-periods, in our revised estimates, SAFER is significant during the Burns chairmanship (at the 10% level) and during the monetarist period of Volcker's chairmanship. Split into signals for ease and tightness, signals for ease are significant during what we called the monetarist portion of the Volcker chairmanship and during the Burns chairmanship, (but only at the 11% level); signals for tightness are not significant in any sub-period.

This pattern for the effects of signaling during various chairmanships is quite different than in our earlier paper. There, SAFER was significant for the portion of the Martin period for which we had data (1966:5-1970:1), for the whole Volcker period, as well as for the monetarist sub-period of Volcker's chairmanship. In our earlier study SAFER was not significant for the Burns period.

With signals divided into ease and tightness, in our earlier estimates, signals for ease were significant in the whole Volcker period. Signals for tightness were significant for the Martin period.

B. Effects of Economic State Variables

For the whole period, our current estimates indicate that only the inflation forecast is significant while our earlier estimates indicated forecast GNP growth was also significant. During the Martin chairmanship, while only the inflation forecast was significant in our earlier results, the unemployment forecast is also significant in our current estimates.

¹⁷ The "whole" period here ends in 1994 while in the earlier paper it ended in 1989. We have re-estimated reaction functions through 1989 with the meeting interval as the measure of an observation and this does not affect comparisons for "whole periods" made in the text.

For the Burns chairmanship, both the inflation and unemployment forecasts are significant in our current estimates while neither was significant in our earlier estimates.

For the whole Volcker chairmanship our earlier estimates showed both inflation forecasts and real GNP forecasts to be significant (inflation only at the 10% level), while our new estimates indicate only the inflation forecast is significant. For the monetarist sub-period, the real GNP forecast was the only significant economic state variable in our earlier estimates. Here it is again the only significant state variable and is only significant in the regression where SAFER is split into signals for ease and tightness.

C. Summary

The estimation of monetary policy reaction functions with data re-calibrated to the periodicity of FOMC meeting dates reveals some significant differences when compared to our earlier study. While one could simply view this as a lack of robustness of the earlier estimates, we would argue that the re-calibration results in more reliable estimates which obviate reverse causation problems and reflect a better alignment of Fed decisions with the actual data available.

V. CONCLUSION

Our revised estimates show significant effects of executive branch signaling to the FED for the whole period (1965-94). Sub-period estimates, however, find that these political pressures are significant only during the Burns chairmanship (1970-78) and during the “monetarist experiment” portion (1979-82) of the Volcker chairmanship. We found no evidence that such pressures significantly influenced monetary policy during the Greenspan years (1987-94).

With respect to economic state variables, our estimation pre-and post- 1979 show the Fed responding significantly to inflation and to either the forecast of the unemployment rate (pre-1979) or the GNP growth forecast (post-1979). Moreover, as found by Clarida, Gali and Gertler (2000), using a different methodology, we find that monetary policy appears to have assumed a much more

aggressive stance on inflation post-1979.

Estimates of the reaction function for the Martin years of our sample and for the Burns period are consistent with the overall pre-1979 finding that the Fed responded to inflation and unemployment forecasts. Estimates for the Volcker and Greenspan chairmanships show a significant response to inflation in the Volcker years and to unemployment and GNP growth in the Greenspan years. The lack of significance for the inflation forecast in the Greenspan period may be the result of too little sample variation in inflation over these years (1987-94). The positive response of the federal funds rate to the GNP growth forecast during the Greenspan period may represent a response to expected future inflationary pressure - - so-called preemptive anti-inflationary strikes.

More generally, as a cautionary tale, our results suggest that econometric studies should perhaps give more consideration to the way time series data are constructed. The usual practice of using monthly, quarterly, or annual data implicitly assumes it is consistent with the way real time information becomes available and is used by real time decision makers. When this is not the case, such practice may give significantly mis-leading results.

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