Majority Rule, Consensus Building, and the Power of the Chairman: Arthur Burns and the FOMC

Henry W. Chappell, Jr.
Department of Economics
University of South Carolina
Columbia, South Carolina 29208
chappell@moore.sc.edu

Rob Roy McGregor
Department of Economics
University of North Carolina at Charlotte
Charlotte, North Carolina 28223
rrmcgreg@email.uncc.edu

Todd Vermilyea
International Banking and Finance
Office of the Comptroller of the Currency
Washington, DC
Todd.Vermilyea@occ.treas.gov

We acknowledge the research assistance of Matthew Birmingham, Steven Nape, Matthew Neidell, Ann Poovey, Paul Prochaska, and David Ramsey, and helpful comments from Brian Roberts, Kevin Grier, Kenneth West, seminar participants at Clemson University and the University of South Carolina, and anonymous referees. We are grateful to Normand Bernard and Shirley Tabb of the Federal Reserve Board, who have provided us with valuable documents related to the activities of the FOMC. Financial support has been provided by NSF grants SBR-9422850 and SBR-9423095 and by the University of North Carolina at Charlotte. The views expressed are those of the authors and do not necessarily reflect the views of the Office of the Comptroller of the Currency or the Department of the Treasury.

December 10, 2002
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Department of Economics
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Abstract

This paper investigates decision-making within the Federal Open Market Committee of the Federal Reserve, focusing on the competing pressures of majority rule, consensus-building, and the power of the Chairman. To undertake this analysis, we have constructed an original data set recording desired federal funds rates for each member of the Committee over the 1970-1978 period. We empirically link individuals’ policy preferences to adopted policies using generalized versions of the median voter model and alternative specifications. Our results confirm a disproportionate influence of the Chairman in the policy process; they also confirm that other voting members of the Committee have an important impact on policy choices. Estimates indicate that the Chairman exercises 40% to 50% of the voting weight in Committee decisions.
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In many countries, including the United States, monetary policy decisions are made by a committee, not by an individual with a well-defined linear quadratic preference function. This institutional “detail” may—and probably does—have important behavioral consequences (Blinder, 1997, p. 16).

I. Introduction

Monetary policy decisions are adopted by majority approval of the voting members of the Federal Reserve’s Federal Open Market Committee (FOMC), which include the seven members of the Board of Governors and five of the twelve presidents of district Federal Reserve Banks. While decisions are formally majoritarian, the Board Chairman has often been portrayed by the media as a monetary policy dictator. For example, the May 10, 1982, issue of U.S. News and World Report listed then-Chairman Paul Volcker second behind President Ronald Reagan in its annual ranking of the most powerful individuals in the United States. The academic literature on monetary policymaking also suggests a prominent role for the Chairman. Woolley (1984) has suggested that the Chairman’s roles as liaison with external clients and resource allocator within the Fed give him leverage over the FOMC, and other research has documented both the influence of various Chairmen on monetary policy decisions and the factors that have shaped their policy positions.¹

While both majoritarian pressures and an enhanced role for the Chairman are present when the FOMC makes decisions, achieving consensus is also thought to be an important goal for the Committee. Internal consensus gives the Fed power and credibility in dealing with external clients, including the President, the Congress, and the public.² Indeed, FOMC records rarely show explicit evidence of divisiveness. Although the need to garner majority support and
achieve consensus may sometimes limit the power of the Chairman, the presence of an ethic favoring consensus might accentuate it. For example, if members are reluctant to challenge proposals offered by an agenda-setting Chairman, then he may be able to tilt outcomes toward his favored positions.

In this paper, we study the aggregation of preferences within the FOMC, focusing on the competing pressures of majority rule, consensus-building, and the preeminence of the Chairman. Given that the FOMC uses majority voting, the median voter model provides a starting point for our analysis. We have extended that model to permit an enhanced role for the Board Chairman and have formulated alternative models to capture the influence of minority views. To estimate these models, we have constructed an original data set that contains detailed information on the policy preferences of individual members of the FOMC and the Committee’s adopted policies.

The time frame for our analysis is the 1970-1978 period when Arthur Burns served as Chairman. Data considerations are partly relevant for the selection of this period. The textual records of FOMC deliberations that provide our primary sources of data on individual preferences are not available from 1978 (after Burns’s departure) through 1980, nor are they available after 1996 (because of a five-year lag in reporting). Although transcripts are available for the 1981-1996 period, variations in operating procedures make coding member policy preferences over those years more difficult. The Burns years are interesting from a policymaking perspective because they were characterized by highly variable macroeconomic conditions; they have current relevance because the Committee’s funds rate targeting procedure resembles current practice.
The remainder of this paper proceeds as follows. Section II describes sources of data on FOMC deliberations, and section III explains how those data are used to measure Committee members’ preferences. Section IV introduces empirical models that relate individual preferences to adopted policies, and in section V we present estimates of those models. Conclusions follow in section VI.

II. Data Describing Policy Preferences of Individual FOMC Members

Until 1976, the FOMC published (after a five-year lag) records of each of its meetings in a document called the Memorandum of Discussion. The Memoranda included edited transcripts of all discussion that took place in the meetings. In 1976, the FOMC stopped publishing the Memoranda, but it continued to audiotape proceedings and transcribe the recordings. Although the Fed has not released official transcripts for the 1976-1978 period, we have obtained copies of the original transcripts from Arthur Burns’s personal papers archived in the Gerald Ford Presidential Library in Ann Arbor, Michigan. Combining the 1970-1976 Memoranda with the 1976-1978 Ford Library transcripts provides us with detailed records of all 99 FOMC meetings held during the Burns era. These documents report statements of policy preferences for Committee members who spoke in the meetings.

Using these documents, we have coded information describing both the Committee’s target funds rate and funds rates preferred by individual Committee members in each meeting. The Committee’s target is measured as the midpoint of the federal funds rate range associated with the monetary policy directive adopted in each meeting. In most cases, individuals’ desired funds rates could be directly inferred in a similar fashion from their recorded statements. We
directly code a member’s desired rate whenever the member stated a quantitative target range, expressed a preference for a staff proposal associated with a quantitative target range, or expressed agreement with another member whose preferred range was determined by one of these methods. For our 99-meeting sample, we were able to directly code a desired funds rate for 1427 (80.1%) of the 1782 member observations (including both voting and non-voting member observations).  

In the remaining 355 observations, individuals failed to directly state a funds rate target range; however, their comments provided some indication of their preferences. For these observations, we have coded a qualitative variable to describe preferences. To do so, we first established a benchmark policy, denoted $\tilde{R}$, with which members’ preferences could be compared in each meeting. In quantitative terms, $\tilde{R}$ was measured as the midpoint of the funds rate target range associated with the Board staff’s median policy proposal.  

In the subsequent “policy go-around,” members’ comments were coded to indicate (1) a preference for a policy that was “easier” than the median staff proposal, (2) a preference for a policy that was “tighter” than the median staff proposal, or (3) no clear direction of preference relative to the median staff proposal. We characterize these codings as “leans toward ease,” “leans toward tightness,” or “assents.” In practice, members’ statements were often framed in comparison to staff proposals, so, with few exceptions, classifying positions was straightforward.
III. Imputing Desired Interest Rates

To calculate a median or mean desired federal funds rate across Committee members in a meeting, one must be able to measure the desired rates of all members, not just most of them. With that purpose in mind, in this section we describe how individuals’ desired funds rates are imputed for the 19.9% of the sample observations where members’ desired funds rates were not directly stated. To do so, we estimate monetary policy reaction functions for each Committee member and then use the reaction functions to calculate expected values for desired funds rates, conditional on the information provided by leaning positions.

III.A A Method for Estimating Individual Reaction Functions

Assume that Committee member \(i\) has a desired interest rate reaction function of the form

\[
R^*_it = X_i \beta_i + \sigma_i e_i, \quad e_i \sim N(0,1).
\]  

(1)

In this equation, \(R^*_it\) is member \(i\)’s desired federal funds rate target for the policy directive to be chosen in meeting \(t\). Right-hand side variables in (1) include indicators of macroeconomic conditions that are thought to influence policy decisions. Equation (1) is similar to monetary policy reaction functions found in the literature, but the dependent variable is an individual’s desired federal funds rate rather than the realized value of a target variable. If \(R^*_it\) were always observed, this equation could simply be estimated by ordinary least squares.

When \(R^*_it\) is not observed, we instead observe either leaning or assenting positions defined in relation to the staff midpoint proposal, \(\tilde{R}_t\). Because such information is informative
about preferences, we wish to use it in both estimation and imputation procedures. To do so, we assume that leaning positions are observed when a member’s desired funds rate, \( R_{it}^* \), differs sufficiently from the staff proposal, \( \tilde{R}_t \). More specifically, member \( i \)'s behavior is described by the following conditions:

\[
\text{If } R_{it}^* - \tilde{R}_t > \lambda_i \text{ then } V_{it} = 1 \hspace{1cm} \text{(Member } i \text{ leans for tightness),} \hspace{1cm} (2.a)
\]

\[
\text{If } R_{it}^* - \tilde{R}_t < -\lambda_i \text{ then } V_{it} = -1 \hspace{1cm} \text{(Member } i \text{ leans for ease),} \hspace{1cm} (2.b)
\]

\[
\text{If } -\lambda_i \leq R_{it}^* - \tilde{R}_t \leq \lambda_i \text{ then } V_{it} = 0 \hspace{1cm} \text{(Member } i \text{ assents).} \hspace{1cm} (2.c)
\]

The first condition says that member \( i \) leans for tightness when his desired funds rate exceeds the staff proposal by more than \( \lambda_i \) units (where \( \lambda_i \) is an estimable threshold parameter).

Similarly, the second condition says that member \( i \) leans for ease when his desired funds rate is less than the staff proposal by more than \( \lambda_i \) units. Finally, the third condition says that member \( i \) assents when the absolute value of the difference between his desired interest rate and that proposed by the staff is less than or equal to \( \lambda_i \) units.\(^{10}\) Substituting (1) into conditions (2) above, we eliminate \( R_{it}^* \) and obtain conditions (3):

\[
\text{If } e_{it} > a_{it} \text{ then } V_{it} = 1, \hspace{1cm} (3.a)
\]

\[
\text{If } e_{it} < b_{it} \text{ then } V_{it} = -1, \hspace{1cm} (3.b)
\]

\[
\text{If } b_{it} \leq e_{it} \leq a_{it} \text{ then } V_{it} = 0, \hspace{1cm} (3.c)
\]
where \( a_i = \frac{\lambda_i + \tilde{R}_i - \mathbf{X}_i\beta_i}{\sigma_i} \) and \( b_i = \frac{-\lambda_i + \tilde{R}_i - \mathbf{X}_i\beta_i}{\sigma_i} \). Given the normality of \( e_{it} \), conditions (3) describe an ordered probit model for observations where only “leaning” positions are available to characterize preferences. Combining observations where \( R_{it}^* \) is observed with those where it is not, it is possible to obtain estimates of the individual reaction function parameters \((\beta_i, \lambda_i, \sigma_i)\) with a mixed OLS-probit model.\(^{11}\)

### III.B Imputing Desired Funds Rates

After estimating parameters, we use the individual reaction functions to impute values for \( R_{it}^* \) for cases where that variable was not observed. Expected values for member \( i \)'s desired interest rate in meeting \( t \) (conditional on exogenous variables, model parameters, and leaning positions) are given by the following conditions:\(^{12}\)

If \( V_{it} = 1 \) then \( E(R_{it}^*) = \mathbf{X}_i\beta_i + \sigma_i \frac{f(a_i)}{1 - F(a_i)} \), \hspace{1cm} (4.a)

If \( V_{it} = -1 \) then \( E(R_{it}^*) = \mathbf{X}_i\beta_i - \sigma_i \frac{f(b_i)}{F(b_i)} \), \hspace{1cm} (4.b)

If \( V_{it} = 0 \) then \( E(R_{it}^*) = \mathbf{X}_i\beta_i + \sigma_i \frac{f(b_i) - f(a_i)}{F(a_i) - F(b_i)} \). \hspace{1cm} (4.c)

In these conditions, \( f \) is the standard normal density function, \( F \) is the standard normal cumulative distribution function, and \( a_i \) and \( b_i \) are defined as before.\(^{13}\)

### III.C Special Issues Concerning the Chairman
Our empirical investigation focuses attention on the influence exerted by the Chairman in Committee deliberations. This implies that accurate measurement of the Chairman’s position is particularly important. Although we have followed similar procedures for coding the position of the Chairman and those of other members, two issues require special attention.

First, imputed policy preferences are subject to measurement error, and the consequences of measurement error are likely to be most acute when the Chairman’s preference is imputed. To minimize the possibility of bias related to measurement error, whenever the Chairman’s preferred funds rate is included in an empirically estimated model we will restrict the sample to observations where the Chairman has directly stated a preferred policy.

Second, in many meetings Burns spoke last, proposing language for a directive. Such proposals, coming from Burns, might be construed as an indication of his preferences. However, if he were simply summarizing the Committee view, this interpretation would be misleading. Further, if Burns’s policy preferences were inferred on the basis of such statements, his measured preference could be spuriously correlated with the adopted target, and estimates of his influence over the Committee would probably be overstated.

To avoid the latter problem, we have reviewed each of Burns’s statements to ensure that we do not code a desired funds rate for him when he is actually summarizing the Committee view. We have two criteria for distinguishing such cases. First, when Burns directly stated a target range and spoke early in the meeting (operationally, in the first-half of the speaking order), he could not have been summarizing. This was the case in 43 of the 99 meetings held in our sample period. Second, when Burns spoke late, he sometimes explicitly noted that his
proposed targets reflected his personal preference. If we add these cases, we can directly infer desired funds rates for Burns in 63 of the 99 meetings. In subsequent empirical work, we primarily use the smaller 43- and 63-observation samples in which the Burns policy proposal is both directly stated and clearly a reflection of his own preference.

III.D Individuals’ Reaction Functions: Empirical Models

Our empirical specification for individuals’ reaction functions, equation (1), is similar to those that have been used in previous reaction function studies. Explanatory variables include the actual federal funds rate prevailing in the week before the FOMC meeting ($R_{t-1}$), the average money growth rate in the three months prior to the month of the meeting ($M_1$), and two-quarter-ahead forecast values for the rate of inflation ($\hat{P}$), the rate of growth of real GNP ($\hat{Y}$), and the civilian unemployment rate ($\hat{U}$), all measured as percentages. Forecast data are obtained from the original Green Books available to members at the time of the meeting.\(^\text{16}\)

Our reaction function specification includes an additional explanatory variable that has not been employed in reaction function studies: the midpoint of the Board staff’s target range for the funds rate, $\tilde{R}_t$, as defined earlier. This variable captures two effects: (1) the influence that the staff exerts on members’ subsequently stated preferences and (2) the effect of omitted economic variables that influence the desired funds rates of both the staff and Committee members. Although we cannot disentangle these effects empirically, that is not our purpose—we simply wish to specify a model that has good predictive power.\(^\text{17}\)

Although the individual reaction functions used to impute desired funds rates are incidental to the primary concerns of this paper, they can be useful in describing differences in
policy preferences across members. To illustrate this, Table 1 provides estimates for several Committee members. These estimations employed all meeting observations for which the individual was either a voting or non-voting participant. Because the staff midpoint is itself responsive to economic conditions, coefficients on the economic variables primarily reflect differences between desired policy responses of the staff and those of individual Committee members. For example, in the reaction function for Darryl Francis, the coefficient on money growth is positive and significantly different from zero, suggesting that Francis’s desired interest rate was more responsive to money growth than the staff target was.

III.E Preference Profiles for Selected Meetings

Using the method described in section III.B, we have imputed desired interest rates as needed and constructed complete preference profiles for all of the FOMC meetings in our sample period. For illustrative purposes, in Table 2 we provide preference profiles for three selected meetings. These examples show that there is considerable variation in members’ desired funds rates over time. For example, in March 1975 all members’ desired rates were between 4.50% and 5.50%, but in May 1973 desired rates were all between 7.5625% and 7.875%. The intertemporal variation in interest rates, along with the tendency for members to state preferences close to prevailing rates, leads to high correlations between the time series for individuals’ desired rates. Table 2 also shows that there are smaller, but notable, differences across individuals within meetings. The existence of preference variation across members within a meeting is necessary if we are to draw inferences about the distribution of influence within the Committee.
The patterns of influence suggested by these examples are varied. In the March 1975 meeting, the adopted funds rate was exactly equal to the median of the desired rates of the Committee’s members; the median was also close to the mean. However, in May 1973, the chosen target of 7.5625% was less than both the median and the mean. The target was instead set equal to the rate advocated by Chairman Burns, whose preferred rate was lower than that of all other voting members. Yet another scenario is suggested by the January 1977 data. In that meeting, the median desired rate was 4.75%, with Chairman Burns concurring. However, a sizable minority of four members advocated a lower rate. The chosen target of 4.6875% appears to reflect a willingness of the majority to accommodate the views of a strong minority, perhaps in an effort to achieve unanimity in the formal vote. These examples suggest that Committee dynamics may be complex and varied, with views of the Chairman and majority and minority factions of the Committee all exerting influence.

IV. FOMC Decision-Making: Empirical Models

We next investigate econometric models of committee decision-making, beginning with the median voter model. This model specifies that the Committee decision will be equal to the median of the desired policy positions of the voting members, leading to the following regression specification:

\[ \bar{R}_t = \phi_0 + \phi_1 MEDIAN_t + u_t. \] (5)
In this equation, $MEDIAN_t$ is the median of the desired federal funds rates of members voting in meeting $t$, and $R_t$ is the target federal funds rate adopted in the monetary policy directive. The median voter hypothesis requires that $\phi_0$ equal zero and that $\phi_1$ equal one.

If decision-making at the FOMC follows a more consensual pattern, one would expect the adopted policy directive to broadly reflect the views of all Committee members, not just those of the median voter. To incorporate the Fed’s concern for consensus, we propose a model in which the mean of the desired positions of the voting Committee members replaces the median:

$$ \bar{R}_t = \phi_0 + \phi_1 MEAN_t + u_t. $$

(6)

The mean voter hypothesis also requires that $\phi_0$ equal zero and that $\phi_1$ equal one.

The simple median and mean voter models can easily be altered to permit augmented power of the Chairman, influence of non-voting members, and differential impacts of Governors and Bank presidents. A simple way to permit added influence of the Chairman is to add his desired funds rate, $BURNS$, to equations (5) and (6), our base specifications. In similar fashion, by adding an appropriate variable, we can test whether non-voting members have any influence on policy and whether their influence is as great as members with formal voting rights. Further, by separately including mean desired funds rates for Governors and for Bank presidents, we can test the hypothesis that members in these groups wield equal power within the Committee.
V. FOMC Decision-Making: Empirical Results

As a preliminary matter, we tested the target and desired interest rate measures that appear in our empirical models for the presence of unit roots. We could not reject the unit root null at the 0.05 level for any of our interest rate measures (detailed test results are provided in an appendix available from the authors). Under the assumption that all variables are I(1), we then tested each of our specifications for the existence of a cointegrating relationship. In each case, the results detected the presence of cointegration (as one would expect if the adopted target were a weighted average of the target values preferred by subgroups of Committee members). This result implies that OLS estimates of our committee decision-making models, with variables expressed in level form, are consistent. However, standard statistical procedures are not appropriate for some hypothesis tests we undertake; in those cases we have employed Monte Carlo simulations to calculate appropriate test statistics.\(^\text{19}\)

In the rest of this section, we describe empirical results for the models of FOMC decision-making we have formulated. For this analysis, we use our sample of 99 observations on FOMC meeting outcomes over the 1970-1978 period, as well as selected sub-samples where the Chairman’s preferences are measured more accurately.

V.A Mean and Median Voter Models

The first two columns of Table 3 provide OLS estimates of equations (5) and (6), the simple median and mean voter models, for the complete sample of 99 meeting observations.\(^\text{20}\) The results are consistent with the predictions of both models. In both the median and mean voter specifications, we fail to reject the key model implications: \(\phi_0\) is not significantly different...
from zero and $\phi_1$ is not significantly different from one. For all specifications, adjusted-$R^2$ values are above 0.990.

\textbf{V.B  The Power of the Chairman}

In the remainder of the paper, we investigate specifications that permit an enhanced role for the Chairman. To avoid the measurement error problems identified earlier, we employ either the 43-observation sub-sample in which Burns spoke in the first half of the order (and presumably was not summarizing) or the 63-observation sub-sample which adds observations in which he spoke late, but noted that his proposed range reflected his own preference.\textsuperscript{21}

The last four columns of Table 3 report results of regressions that add \textit{BURNS} to the base specifications for the two sub-samples.\textsuperscript{22} While our estimation does not impose a restriction that coefficients on the Chairman and the mean or median sum to one, in practice they come very close to doing so; in all cases, we fail to reject the null hypothesis that the relevant coefficients sum to one.\textsuperscript{23} Coefficients therefore approximate relative weights in the policy process. In each equation, the Chairman coefficient is significantly different from zero at the 0.05 level or better, and the implied voting weight of the Chairman (including his contribution to the mean or median) is approximately 40\% to 50\%.\textsuperscript{24} On the basis of these results, we can strongly reject the hypothesis that the impact of the Chairman is no different from that of rank-and-file members of the Committee. The evidence also rejects the view that the Chairman is dictatorial. The coefficients on Committee mean and median positions are significantly different from zero in all equations, and the implied voting weights are usually larger than the Chairman’s.
V.C  The Influence of Non-Voting Members

Although Reserve Bank presidents attend all FOMC meetings, they do not always serve as voting members. This invites the question of whether they have any influence on policy choices while serving in a non-voting capacity. In the first four columns of Table 4, we provide results for models that permit non-voting members of the Committee to influence the policy outcome. In the first two columns we add ALTMEAN, the mean position of the non-voting alternates who spoke at a meeting, to a base model that already includes the mean position of voting members. In the next two columns, we add ALTMED, the median position calculated over all members, to a model that already includes the median calculated over voting members only.

The results indicate that non-voting alternates have no appreciable influence over policy outcomes. In all cases, measures of mean and median positions including alternates are dominated by those including voting members only; none of the variables measuring alternate preferences has a coefficient significantly different from zero. If policymaking in the FOMC is consensual, that consensus does not appear to encompass the views of non-voting members.

V.D  The Relative Power of Governors and Bank Presidents

Governors and district Reserve Bank presidents are appointed via different procedures and have differing clienteles and responsibilities. These arrangements might lead to different degrees of policymaking power. Governors could be more powerful because of their proximity to the Chairman and because they have statutory power over the setting of the discount rate and reserve requirements. Alternatively, because Bank presidents do not depend on the Chairman for staff support, they may confront the Chairman more effectively when disagreements arise.
The fifth and sixth columns of Table 4 report the results of specifications that generalize the mean voter model to permit differential power for Governors and Bank presidents. These specifications include $BURNS$, $MEANGOV$ (the mean desired rate for Governors, excluding the Chairman), and $MEANBP$ (the mean desired rate of voting Bank presidents) as explanatory variables. In both sub-samples, coefficients of the mean positions of Governors and Bank presidents are significantly different from zero, so both groups have an impact on outcomes. Assessing whether Governors and Bank presidents have differential power is slightly complicated by the fact that the groups are differently sized. If individual Governors and Bank presidents are equally powerful, coefficients should be proportional to group size, and the following restriction should hold:

$$\frac{\beta_G}{\beta_{BP}} = \frac{N_G}{N_{BP}}.$$ 

In this condition, $\beta_G$ and $\beta_{BP}$ are coefficients for the two added variables, and $N_G$ and $N_{BP}$ are the average numbers in the Governor and Bank president groups. For the estimations reported in Table 4, the equal power restrictions cannot be rejected, although the power of the test to discern such differences appears to be low.

V.E Tests of Non-Nested Hypotheses: Median and Mean Voter Models

In the preceding analysis, we have used both the mean and the median to measure group preferences in our empirical models. Both measures perform well in terms of explaining outcomes, but it may be revealing to formally test median- and mean-voter models against one another. For this purpose, we compare the generalized mean voter model, which includes
BURNS and MEAN, to a generalized median voter model, including BURNS and MEDIAN. The simplest way to do so is with a non-nested $F$-test. To perform this test, we include BURNS, MEAN, and MEDIAN together in a hybrid “supermodel.” Estimates of such a model are provided in the last two columns of Table 4. In the case at hand, with one regressor unique to each hypothesis, a non-nested $F$-test is equivalent to a $t$-test of the significance of the regressor originating with the “alternative” model (each hypothesis is in turn treated as the “null” or “alternative” hypothesis). In the 63-observation sample, both MEAN and MEDIAN are significant, implying that each model is rejected in light of information provided the alternative hypothesis. In the 43-observation sample, only the MEAN coefficient is significantly different from zero, implying that the median voter model is rejected in favor of the mean voter model. While these results give a bit more support to MEAN than MEDIAN, it would clearly be premature to conclude that majoritarian pressures are absent.

VI. Conclusions

Employing original data sets and estimation methods, we have measured desired funds rate targets for each voting member of the FOMC over a sequence of meetings. We then investigated how collective choices made by the Committee are related to the stated preferences of its members. The formal operating procedures of the FOMC require that adopted policy directives be approved by a majority vote of its members, so the median voter model provided a starting point for our analysis. Because observers of monetary policymaking emphasize the importance of the role played by the Chairman and the desire for achieving consensus, our analysis also investigated these aspects of the policy process.
Our empirical results substantiate the claim that the Chairman carries greater policymaking weight than rank-and-file Committee members. The estimated voting weight for the Chairman (including his contribution to the mean and median positions) is approximately 40% to 50%. Although we confirm the view that the Chairman wields enhanced power, we are also able to refute the view that he is dictatorial, since median or mean voter positions are also significant in explaining policy outcomes. Neither the mean nor median voter position is a clearly preferable indicator of Committee sentiment, suggesting that both majoritarian and consensual pressures may be important. Finally, we find that non-voting Bank presidents have no influence over outcomes and detect no significant differences in the power of Governors and voting Bank presidents.
References


Notes

1 See, for example, Hakes (1990), Havrilesky (1993), Kettl (1986), and Krause (1994). The voting weight of the Chairman has been econometrically estimated by Chappell, Havrilesky, and McGregor (1993), but their work relied on less revealing data than those to be employed in this paper.

2 Havrilesky and Schweitzer (1990), Greider (1987), Krause (1994, 1996), and Knott (1986) document the importance of consensus within the FOMC and the role of the Chairman in facilitating that consensus.

3 From 1979 through 1982, the Fed targeted non-borrowed reserves. Through the remainder of the 1980s, it formally targeted borrowed reserves, but gradually moved back toward a funds rate target in practice. This ambiguity over the primary policy instrument makes the coding of preferences difficult.

4 In the Burns years, the funds rate provided the primary target, but rates were permitted to fluctuate within specified ranges. The current operating procedure determines a more precise level for the target.

5 Because we are coding Committee members’ desired policy settings, the question of whether members might misstate their true preferences naturally arises. Although we recognize this possibility, the issue is not central to our purpose. Our objective is to investigate the mapping between members’ stated preferences and the Committee’s chosen policy. Truthful or not, members’ statements within the meetings are the means by which they provide their input to the Committee.

6 The Board staff reported alternative policy scenarios in the Blue Book prepared for each meeting of the Committee. When the staff presented an odd number of scenarios, the staff midpoint is defined as the midpoint of the range prescribed by the median scenario. When the staff presented an even number of scenarios, our benchmark is the midpoint of the range defined by the union of the ranges of the two median scenarios.

7 Further details on data collection and coding procedures are provided in an appendix available from the authors.

8 Reaction functions are regression equations that explain the setting of a policy instrument, like the federal funds rate, with variables describing prevailing or predicted macroeconomic conditions. Khoury (1990) provides a survey of this literature. Yohe (1966), Canterbury (1967), Belden (1989), Havrilesky and Gildea (1991a, 1991b, 1992), Havrilesky and Schweitzer (1990), and Tootell (1991) have examined dissent voting patterns on monetary policy directives. Because dissenting votes occur infrequently, these studies are limited in what they can reveal about members’ policy preferences.
9 We assume that an individual’s decision on whether to state an explicit desired funds rate is non-strategic and, consequently, econometrically exogenous. Records of Committee deliberations show that when members fail to state explicit rates, they usually provide meaningful qualitative information about their views (as we would expect, given that members want to influence the outcome). The failure to reveal explicit numerical targets appears to be more a matter of expression than one of strategic behavior.

10 We interpret \( \lambda_i \) primarily as a parameter describing the behavior of individuals, who choose whether or not to distinguish their preferences from the policy proposed by the staff. However, it also reflects the behavior of coders and our prescribed coding procedures. For example, a more stringent standard for identifying leaning positions would result in a larger value of \( \lambda_i \).

11 Further details on estimation of individual reaction functions and imputation of desired interest rates are provided in an appendix available from the authors.

12 These expressions are derived in a manner that follows Tobin (1958). Additional details are provided in the appendix available from the authors. We use estimated parameters in conditions (4) when calculating imputed values of desired funds rates.

13 Two qualifications should be noted. First, estimating the combined OLS-probit model requires leans in at least two of the three categories. For a few members, this requirement was not met. For those individuals, we use their OLS results, along with \( \lambda \) and/or \( \sigma \) values taken from a pooled estimation using data for all members, to impute desired interest rates. Second, some individuals do not have enough observations to allow us to estimate the combined OLS-probit model. Since these individuals are all vice-presidents of district Reserve Banks, to impute their desired interest rates, we combine these individuals with the presidents under whom they served.

14 Although measurement error also affects measures of mean and median positions of Committee members, it will be smaller in magnitude because most member positions are observed (not imputed) and because sample means and medians have smaller variances than individual observations.

15 Because the Chairman chooses when to speak and what to say, selection into the smaller sub-samples is not strictly exogenous. We have estimated models correcting for selection bias and have obtained results that are similar to those reported in the text.
Green Books are prepared for each Committee meeting by the Federal Reserve Board staff. Our measures are generally calculated as an average of forecasts for the current quarter and the upcoming quarter. For several meetings where only the current quarter forecast is available, that measure is employed. The rate of inflation is calculated from the implicit price deflator for real GNP.

Our estimations apparently capture much of the variation in members’ preferred targets. For the mixed OLS-probit model, $R^2$ is not an appropriate goodness-of-fit measure; one cannot use the observations where only qualitative data are available in an $R^2$ calculation. However, for identical specifications estimated over samples including only observations where desired interest rates were directly observed, OLS estimates produced $R^2$ values at 0.979 and above for all individuals. Therefore, it is likely that the model has good predictive power. In another paper (Chappell, McGregor, and Vermilyea, 2002), we have estimated conventionally specified individual reaction functions for the purpose of describing policy differences across FOMC members.

When the number of voters is even, MEDIAN is measured as the midpoint of the two median positions.

Specifically, with a single I(1) regressor, standard inference procedures are not appropriate for testing the null hypothesis that $\phi_1$ equals one, nor are they appropriate for testing the null hypothesis that the coefficients sum to one in specifications in which we have two or more I(1) regressors. Monte Carlo methods for these non-standard cases are described in detail in the appendix available from the authors. In the case where there are two or more I(1) regressors, it is possible to interpret individual coefficients’ $t$-statistics in the usual way, however (see Hamilton, 1994; Sims, Stock, and Watson, 1990; and West, 1988).

The results in the second column have been corrected for first-order serial correlation, whose presence was indicated by the Durbin-Watson statistic from the original OLS results.

If we do employ the full sample of 99 observations, including 36 observations with imputed values for the Chairman’s position, then the estimated coefficient of BURNS is smaller. This result is consistent with the existence of a bias toward zero in the presence of measurement error. The BURNS coefficient estimate remains significantly different from zero, however.

Because of gaps in the data series, the Durbin-Watson statistic is not appropriate for testing for serial correlation in the sub-samples. In addition to the reported OLS estimations, we have estimated all equations reported in the paper under an
assumption of first-order serial correlation and adjusting for gaps in the data. In all cases, we find that results are essentially unchanged when serial correlation is assumed.

23 Estimates change very little when the coefficients are constrained to sum to one. Constant terms are often significantly different from zero, but are nevertheless small in magnitude.

24 These results are similar to those of Maisel (1973), who subjectively estimated that the Chairman had 45% of the voting weight. Maisel’s estimates are not strictly comparable to ours, however. Maisel divided power between the Chairman, Bank presidents, Governors, and Board staff, while our models do not incorporate an independent role for the staff.

25 In two meetings, no alternates spoke, and \( ALTMEAN \) and \( ALTMED \) are therefore missing. This results in different sample sizes in some estimations in Table 4.

26 Maisel (1973, p. 110) subjectively estimated that Governors, as a group, had twice as much influence over monetary policy as the Reserve Bank presidents.

27 Similar results are obtained when median positions of the Bank presidents and Governors are used instead of means.

28 Because of vacancies and absences, the number of Governors (excluding the Chairman) in each meeting varies. In the 43-observation sample, the average value for \( N_G \) was 5.69; in the 63-observation sample, it was 5.60. The number of voting Bank presidents is always five, since absent Bank presidents are replaced by substitutes.

29 The \( t \)-statistic for the test of the equal power hypothesis is –0.418 in the 43-observation sample and 0.232 in the 63-observation sample. The tests are not extremely discriminating, since we also are unable to reject the hypothesis that Governors are twice as powerful as Bank presidents.

30 We obtain similar results using a Cox test for non-nested hypotheses. In the 43-observation sample, the mean voter hypothesis is not rejected, but the median voter hypothesis is rejected (at the 0.05 significance level). In the 63-observation sample, mean and median voter models are each rejected in light of information provided by the alternative (again at the 0.05 significance level). See Davidson and MacKinnon (1981), MacKinnon (1983), and Cox (1961) for further details on these tests.
Table 1. Individuals’ Desired Federal Funds Rate Reaction Functions

<table>
<thead>
<tr>
<th>Variable/Equation</th>
<th>Brimmer $N = 54$</th>
<th>Wallich $N = 48$</th>
<th>Morris $N = 93$</th>
<th>Francis $N = 59$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.454</td>
<td>0.636</td>
<td>-0.284</td>
<td>1.486</td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td>(0.271)</td>
<td>(0.315)</td>
<td>(0.001)*</td>
</tr>
<tr>
<td>$\bar{R}_t$</td>
<td>0.573</td>
<td>0.940</td>
<td>0.711</td>
<td>0.809</td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
</tr>
<tr>
<td>$R_{t-1}$</td>
<td>0.373</td>
<td>0.089</td>
<td>0.314</td>
<td>0.025</td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.236)</td>
<td>(0.000)*</td>
<td>(0.800)</td>
</tr>
<tr>
<td>$M\dot{1}$</td>
<td>-0.001</td>
<td>0.022</td>
<td>0.017</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>(0.960)</td>
<td>(0.052)*</td>
<td>(0.019)*</td>
<td>(0.010)*</td>
</tr>
<tr>
<td>$\dot{U}$</td>
<td>-0.133</td>
<td>-0.031</td>
<td>0.005</td>
<td>-0.112</td>
</tr>
<tr>
<td></td>
<td>(0.440)</td>
<td>(0.558)</td>
<td>(0.909)</td>
<td>(0.082)*</td>
</tr>
<tr>
<td>$\dot{P}$</td>
<td>-0.032</td>
<td>-0.093</td>
<td>-0.062</td>
<td>0.089</td>
</tr>
<tr>
<td></td>
<td>(0.649)</td>
<td>(0.061)*</td>
<td>(0.073)*</td>
<td>(0.044)*</td>
</tr>
<tr>
<td>$\dot{Y}$</td>
<td>-0.033</td>
<td>-0.018</td>
<td>0.052</td>
<td>-0.025</td>
</tr>
<tr>
<td></td>
<td>(0.210)</td>
<td>(0.094)*</td>
<td>(0.000)*</td>
<td>(0.098)*</td>
</tr>
<tr>
<td>$\dot{\lambda}$</td>
<td>0.202</td>
<td>0.093</td>
<td>0.087</td>
<td>0.230</td>
</tr>
<tr>
<td></td>
<td>(0.006)*</td>
<td>(0.16)</td>
<td>(0.117)</td>
<td>(0.002)*</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.230</td>
<td>0.182</td>
<td>0.221</td>
<td>0.240</td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
</tr>
</tbody>
</table>

* $p$-values in parentheses. Variables and parameters are defined in Sections III.A and III.D of the paper. *Significant at 0.10 level or better, two-tailed test.
Table 2. Federal Funds Rate Preferences and Outcomes: Examples

<table>
<thead>
<tr>
<th>Member</th>
<th>Desired Funds Rate</th>
<th>Member</th>
<th>Desired Funds Rate</th>
<th>Member</th>
<th>Desired Funds Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayo</td>
<td>7.8750</td>
<td>Wallich</td>
<td>5.5000</td>
<td>Wallich</td>
<td>4.7500</td>
</tr>
<tr>
<td>Hayes</td>
<td>7.8750</td>
<td>Hayes</td>
<td>5.5000</td>
<td>Volcker</td>
<td>4.7500</td>
</tr>
<tr>
<td>Francis</td>
<td>7.8750</td>
<td>Burns</td>
<td>5.5000</td>
<td>Partee</td>
<td>4.7500</td>
</tr>
<tr>
<td>Sheehan</td>
<td>7.6250</td>
<td>Holland</td>
<td>5.3750</td>
<td>Lilly</td>
<td>4.7500</td>
</tr>
<tr>
<td>Morris</td>
<td>7.6250</td>
<td>Mitchell</td>
<td>5.2500</td>
<td>Gardner</td>
<td>4.7500</td>
</tr>
<tr>
<td>Daane</td>
<td>7.6250</td>
<td>Mayo</td>
<td>5.2500</td>
<td>Coldwell</td>
<td>4.7500</td>
</tr>
<tr>
<td>Bucher</td>
<td>7.6250</td>
<td>MacLaury</td>
<td>5.2500</td>
<td>Burns</td>
<td>4.7500</td>
</tr>
<tr>
<td>Brimmer</td>
<td>7.6250</td>
<td>Eastburn</td>
<td>5.0000</td>
<td>Balles</td>
<td>4.7500</td>
</tr>
<tr>
<td>Balles</td>
<td>7.6250</td>
<td>Baughman</td>
<td>5.0000</td>
<td>Kimbrel</td>
<td>4.6560*</td>
</tr>
<tr>
<td>Burns</td>
<td>7.5625</td>
<td>Coldwell</td>
<td>4.8750</td>
<td>Winn</td>
<td>4.6250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sheehan</td>
<td>4.5000</td>
<td>Jackson</td>
<td>4.6250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bucher</td>
<td>4.5000</td>
<td>Black</td>
<td>4.6224*</td>
</tr>
<tr>
<td>Median</td>
<td>7.6250</td>
<td>Median</td>
<td>5.2500</td>
<td>Median</td>
<td>4.7500</td>
</tr>
<tr>
<td>Mean</td>
<td>7.6938</td>
<td>Mean</td>
<td>5.1250</td>
<td>Mean</td>
<td>4.7107</td>
</tr>
<tr>
<td>Adopted Target</td>
<td>7.5625</td>
<td>Adopted Target</td>
<td>5.2500</td>
<td>Adopted Target</td>
<td>4.6875</td>
</tr>
</tbody>
</table>

* Indicates an imputed desired interest rate.
Table 3. Mean and Median Voter Models
Dependent Variable: Target Federal Funds Rate

<table>
<thead>
<tr>
<th>Variable/Equation</th>
<th>Mean N = 99</th>
<th>Median N = 99</th>
<th>Mean with Chair N = 63</th>
<th>Median with Chair N = 63</th>
<th>Mean with Chair N = 43</th>
<th>Median with Chair N = 43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.077</td>
<td>-0.016</td>
<td>-0.045</td>
<td>-0.043</td>
<td>-0.061</td>
<td>-0.060</td>
</tr>
<tr>
<td></td>
<td>(0.310)</td>
<td>(0.769)</td>
<td>(0.061)*</td>
<td>(0.085)*</td>
<td>(0.029)*</td>
<td>(0.055)*</td>
</tr>
<tr>
<td>MEAN</td>
<td>1.012</td>
<td>0.552</td>
<td>0.630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEDIAN</td>
<td>0.999</td>
<td>0.583</td>
<td>0.655</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BURNS</td>
<td>0.455</td>
<td>0.422</td>
<td>0.378</td>
<td>0.352</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.001)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sum_{i=1}^{k} \phi_i$</td>
<td>1.012</td>
<td>0.999</td>
<td>1.006</td>
<td>1.006</td>
<td>1.008</td>
<td>1.007</td>
</tr>
<tr>
<td></td>
<td>(0.1964)</td>
<td>(0.912)</td>
<td>(0.168)</td>
<td>(0.233)</td>
<td>(0.216)</td>
<td>(0.290)</td>
</tr>
<tr>
<td>$\sum_{i=1}^{k} \phi_i = 1$ (Test)</td>
<td>(0.912)</td>
<td>(0.168)</td>
<td>(0.233)</td>
<td>(0.216)</td>
<td>(0.290)</td>
<td></td>
</tr>
<tr>
<td>$\rho^b$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.295</td>
</tr>
<tr>
<td>D.W.</td>
<td>1.713</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{R}^2$</td>
<td>0.997</td>
<td>0.998</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
</tr>
</tbody>
</table>

*p-values in parentheses. Monte Carlo methods are used to calculate p-values for individual coefficients in the first two columns, and for the test that the sum of the coefficients equals one in all columns. Variables and parameters are defined in Section IV of the paper.

*b Serial correlation coefficient (when estimates are corrected for serial correlation).

*Significant at 0.10 level or better, two-tailed test.
Table 4. Model Extensions
Dependent Variable: Target Federal Funds Rate

<table>
<thead>
<tr>
<th>Variable/Equation</th>
<th>Mean</th>
<th>Mean</th>
<th>Median</th>
<th>Median</th>
<th>Presidents and Governors</th>
<th>Presidents and Governors</th>
<th>Hybrid</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=62</td>
<td>N=42</td>
<td></td>
<td></td>
<td>N=63</td>
<td>N=42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.045</td>
<td>-0.053</td>
<td>-0.043</td>
<td>-0.062</td>
<td>-0.045</td>
<td>-0.069</td>
<td>-0.048</td>
<td>-0.063</td>
</tr>
<tr>
<td></td>
<td>(0.079)*</td>
<td>(0.078)*</td>
<td>(0.091)*</td>
<td>(0.045)*</td>
<td>(0.086)*</td>
<td>(0.029)*</td>
<td>(0.042)*</td>
<td>(0.025)*</td>
</tr>
<tr>
<td>BURNS</td>
<td>0.435</td>
<td>0.357</td>
<td>0.370</td>
<td>0.255</td>
<td>0.507</td>
<td>0.440</td>
<td>0.380</td>
<td>0.334</td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.001)*</td>
<td>(0.016)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
</tr>
<tr>
<td>MEAN</td>
<td>0.550</td>
<td>0.680</td>
<td>0.538</td>
<td>0.546</td>
<td></td>
<td></td>
<td>0.347</td>
<td>0.492</td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.001)*</td>
<td>(0.000)*</td>
<td></td>
<td></td>
<td>(0.003)*</td>
<td>(0.002)*</td>
</tr>
<tr>
<td>MEDIAN</td>
<td>0.347</td>
<td>0.492</td>
<td>0.279</td>
<td>0.182</td>
<td></td>
<td></td>
<td>0.347</td>
<td>0.492</td>
</tr>
<tr>
<td></td>
<td>(0.003)*</td>
<td>(0.002)*</td>
<td>(0.027)*</td>
<td>(0.274)</td>
<td></td>
<td></td>
<td>(0.027)*</td>
<td>(0.274)</td>
</tr>
<tr>
<td>ALTMEAN</td>
<td>0.022</td>
<td>-0.030</td>
<td>(0.763)</td>
<td>(0.717)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALTMED</td>
<td>0.097</td>
<td>0.207</td>
<td>(0.548)</td>
<td>(0.228)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEANBP</td>
<td>0.254</td>
<td>0.226</td>
<td>(0.003)*</td>
<td>(0.028)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEANGOV</td>
<td>0.245</td>
<td>0.343</td>
<td>(0.009)*</td>
<td>(0.002)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sum \phi_i$</td>
<td>1.007</td>
<td>1.007</td>
<td>1.006</td>
<td>1.008</td>
<td>1.006</td>
<td>1.010</td>
<td>1.007</td>
<td>1.008</td>
</tr>
<tr>
<td>$\sum \phi_i=1$ (Test)</td>
<td>(0.162)</td>
<td>(0.253)</td>
<td>(0.220)</td>
<td>(0.229)</td>
<td>(0.201)</td>
<td>(0.152)</td>
<td>(0.172)</td>
<td>(0.219)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
<td>0.999</td>
</tr>
</tbody>
</table>

*p-values in parentheses. Monte Carlo methods are used to calculate p-values for the test that the sum of the coefficients equals one. Variables and parameters are defined in Section IV of the paper.
*Significant at 0.10 level or better, two-tailed test.
Appendix

Majority Rule, Consensus Building, and the Power of the Chairman:
Arthur Burns and the FOMC

Section 1. Data Coding Procedures

The Memoranda of Discussion (1970-1976) and Ford Library transcripts (1976-1978) provide detailed records of FOMC deliberations on monetary policy. Transcripts were very lightly edited; the Memoranda slightly more so. Both sources summarize the statements made by individuals within the meetings.

During the 1970s, the FOMC met at approximately monthly intervals. In each meeting it adopted a directive to guide the conduct of monetary policy over the next inter-meeting period. Monetary policy directives are short, sometimes vaguely worded documents, but in the Burns era directives included specific target ranges for the federal funds rate. We measure the adopted policy outcome as the midpoint of the federal funds rate range associated with the directive. In a few cases, policies with “asymmetric midpoints” were explicitly proposed or adopted. An asymmetric midpoint represents the primary target value for policymakers, even though it is not strictly the midpoint within the proposed target range. Whenever asymmetric midpoints were explicitly mentioned, we regarded those as the targets for the given proposals.

In each meeting, the Federal Reserve staff presented the Committee with alternative policy options and associated forecasts, which usually became a focus of subsequent discussion. After the presentation of the staff report, the Chairman called for the “policy go-around,” in which members of the Committee, including both voting and non-voting district Reserve Bank presidents, presented views on appropriate policy choices. At this stage, members usually identified themselves with one of the staff proposals or offered an alternative position. Frequently, members were explicit about desired ranges for the federal funds rate. Based on the textual record contained in the Memoranda of Discussion and the Ford Library transcripts, we have attributed desired federal funds rate targets to individuals when any of the following circumstances prevailed:

(1) The individual explicitly stated a desired range for the federal funds rate.

(2) The individual stated a preference for a staff policy scenario that had an explicit target range for the federal funds rate.

(3) The individual stated that his preference coincided with that of another member of the Committee whose desired funds rate could be inferred by way of (1) or (2) above.
We then calculated each individual’s desired funds rate as the midpoint of the reported range. For our 99-meeting sample, we were able to code a desired funds rate for 1427 (80.1%) of the 1782 member observations (including both voting and non-voting member observations).

For observations where individuals failed to state an explicit funds rate range, we instead coded a qualitative variable to describe preferences. To do so, we first established a benchmark policy with which members’ preferences could be compared in each meeting. We used a Board staff proposal for this purpose. Although the Board staff usually presented several policy scenarios ranging from “easier” to “tighter,” we defined a composite proposal as our benchmark. When the staff presented an odd number of scenarios, our benchmark was the midpoint of the range prescribed by the median proposal. When the staff presented an even number of proposals, our benchmark was the midpoint of the range defined by the union of the ranges in the two median proposals.

In the policy go-around which follows the staff presentation, members’ comments can indicate (1) a preference for a policy which is “easier” than the staff proposal, (2) a preference for a policy which is “tighter” than the staff proposal, or (3) no clear direction of preference relative to the staff proposal. For each Committee member who did not state a desired interest rate, we have used the textual record of Committee deliberations to code member policy positions into these three categories. Members either “lean toward ease,” “lean toward tightness,” or “assent.”

In practice, members’ statements are frequently framed in comparison to staff proposals, so with few exceptions, classifying positions is straightforward. One can think of the staff proposals as points on an interest rate number line. Members’ comments typically place them in particular intervals along that line. For example, the staff may offer scenarios A, B, and C, ranging from easiest to tightest. Without stating a specific target, a member may indicate a preference “close to A, but shaded in the direction of B.” This verbal statement indicates a desire for ease relative to the benchmark staff proposal, which in this case is B. The original transcripts have in all cases been read and coded at least twice by graduate student assistants and once by the authors. Final coding decisions were made by the authors. Of the 355 member observations (again including non-voting Bank presidents) where desired funds rates were not directly inferred, leans for ease were coded in 88 (24.8%) cases, leans for tightness were coded in 81 (22.8%) cases, and assents were coded in the remaining 186 (52.4%) cases.

Section II. The Likelihood Function for Individual Reaction Function Estimation

In this section we present the likelihood function for the estimation of the reaction function for member i, using a sample in which desired interest rates may or may not be observed. We derive the likelihood functions for observations falling into each of four categories: (1) $R_i^*$ is not observed and member i leans for tightness, (2) $R_i^*$ is not observed and member i leans for ease, (3) $R_i^*$ is not observed and member i assents, and (4) $R_i^*$ is observed.
Case I. $R_{it}^*$ is Not Observed and Member $i$ Leans for Tightness

Because $V_{it} = 1$, we know that $R_{it}^* - \bar{\lambda}_i > \lambda_i$, or equivalently, that $e_{it} > a_u$, where
\[
a_u = \frac{\lambda_i + \bar{R}_i - X_i \beta_i}{\sigma_i}.
\]
The likelihood for the observation is given by the probability that we observe this case given the parameter values:
\[
L_{I, it} = \text{Prob}(e_{it} > a_u)
\]
\[
= 1 - F(a_u),
\]
where $F$ is the standard normal cumulative distribution function.

Case II. $R_{it}^*$ is Not Observed and Member $i$ Leans for Ease

Because $V_{it} = -1$, we know that $R_{it}^* - \bar{\lambda}_i < -\lambda_i$, or equivalently, that $e_{it} < b_u$, where
\[
b_u = \frac{-\lambda_i + \bar{R}_i - X_i \beta_i}{\sigma_i}.
\]
The likelihood for this observation is given by:
\[
L_{II, it} = \text{Prob}(e_{it} < b_u)
\]
\[
= F(b_u).
\]

Case III. $R_{it}^*$ is Not Observed and Member $i$ Assents

Because $V_{it} = 0$, we know that $-\lambda_i \leq R_{it}^* - \bar{\lambda}_i \leq \lambda_i$, or equivalently, that $b_u \leq e_{it} \leq a_u$. The likelihood for this observation is given by:
\[
L_{III, it} = \text{Prob}(b_u \leq e_{it} \leq a_u)
\]
\[
= F(a_u) - F(b_u).
\]

Case IV. $R_{it}^*$ is Observed

In this case the likelihood function for observation $t$ is identical to that for an ordinary least squares regression:
\[ L_{IV,i} = \frac{1}{\sqrt{2\pi\sigma_i}} \exp \left[ -\left( \frac{1}{2} \right) \left( \frac{R_i^* - X_i\beta_i}{\sigma_i} \right)^2 \right]. \]

The likelihood function for the sample of observations \( t = 1, \ldots, T \) for member \( i \) is given by:

\[ L_i = \prod_{t=1}^{T} \left( D_{I,i,t} L_{I,i,t} + D_{II,i,t} L_{II,i,t} + D_{III,i,t} L_{III,i,t} + D_{IV,i,t} L_{IV,i,t} \right), \]

where the variables \( D_I, D_{II}, \text{etc.} \), are dummy variables equal to one for the indicated case and otherwise equal to zero.

**Section III. Imputing Desired Interest Rates**

For the three cases where an individual’s desired interest rate is not observed, we describe how to calculate the expected value of that desired interest rate. We will consider three cases corresponding to the three possible qualitative categorizations of a member’s preference relative to the proposed policy of the Federal Reserve staff.

**Case I. Member \( i \) Leans Toward Tightness**

Recall that member \( i \)'s desired interest rate reaction function is given by:

(A.1) \[ R_i^* = X_i\beta_i + \sigma_i e_i \quad e_i \sim N(0,1). \]

Given values for the exogenous variables and for the parameters of the reaction function, and taking expected values on each side of (A.1), we obtain:

(A.2) \[ E(R_i^*) = X_i\beta_i + \sigma_i E(e_i). \]

Because we have observed a lean toward tightness, we know that \( R_i^* - \bar{R}_i > \lambda_i \), or, equivalently, that \( e_i > a_i \), where \( a_i \) is defined as before. Applying Bayes’ Rule, the expected value of \( e_i \) is given by:

(A.3) \[ E(e_i) = \frac{a_i}{1 - F(a_i)}. \]
For a normal density, \( f'(x) = -xf(x) \), so

\[
\int_{a_x}^{\infty} xf(x)dx = -\int_{a_x}^{\infty} f'(x)dx
\]

\[
= -[f(x)]_{a_x}^{\infty}
\]

\[
= f(a_x).
\]

Substituting this result into (A.3), we obtain:

\[
E(e_{it}) = \frac{f(a_x)}{1 - F(a_{it})}.
\]

Then, substituting into (A.2) yields:

\[
E(R^*_t) = X_i \beta_i + \sigma_i E(e_{it}) \cdot
\]

**Case II. Member i Leans Toward Ease**

Again, we have:

(A.2) \( E(R^*_t) = X_i \beta_i + \sigma_i E(e_{it}) \).

Because we have observed a lean toward ease, we know that \( R^*_t - \tilde{R}_i < -\lambda_i \), or, equivalently, that \( e_{it} < b_x \), where \( b_x \) is defined as before. Applying Bayes’ Rule, the expected value of \( e_{it} \) is given by:

\[
E(e_{it}) = \frac{\int_{b_x}^{b_{i_t}} xf(x)dx}{F(b_{it})}.
\]

Using the condition \( f'(x) = -xf(x) \) and integrating yields:

\[
E(e_{it}) = -\frac{f(b_{i_t})}{F(b_{it})}.
\]
Finally, substituting into (A.2) we obtain:

\[ E(R^*_{it}) = X_i \beta_i - \sigma_i \frac{f(b_{it})}{F(b_{it})}. \]

**Case III. Member i Assents**

Once again, we have:

(A.2) \[ E(R^*_{it}) = X_i \beta_i + \sigma_i E(e_{it}). \]

Because member \( i \) assents, we know that \( -\lambda_i \leq R^*_{it} \leq \tilde{R}_i \), or equivalently, that \( b_{it} \leq e_{it} \leq a_{it} \).

Making use of Bayes’ Rule, \( E(e_{it}) \) is given by:

\[ E(e_{it}) = \int_{b_{it}}^{a_{it}} xf(x)dx \]

\[ E(e_{it}) = \frac{f(b_{it}) - f(a_{it})}{F(a_{it}) - F(b_{it})}. \]

Then employing the condition \( f'(x) = -xf(x) \) and integrating, we obtain:

\[ E(e_{it}) = \frac{f(b_{it}) - f(a_{it})}{F(a_{it}) - F(b_{it})}. \]

Finally, substituting into (A.2), the expected value of \( R^*_{it} \) is given by:

\[ E(R^*_{it}) = X_i \beta_i + \sigma_i \frac{f(b_{it}) - f(a_{it})}{F(a_{it}) - F(b_{it})}. \]

**Section IV. Unit Root and Cointegration Tests**

We tested each of our interest rate measures for a unit root using an augmented Dickey-Fuller test. Time plots of our data are shown in Figures A1-A3. Because of the high correlations between our interest rate measures we plot only two series per figure: in A1, Burns’s preferred funds rate and the
Committee’s adopted target funds rate; A2, the Committee mean and median funds rates; and A3, the Governors’ mean and the voting Bank Presidents’ mean. An inspection of Figures A1-A3 does not indicate a trend in any of our interest rate measures. Our unit root tests were therefore conducted using augmented Dickey-Fuller regressions of the form

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \epsilon_t,$$

where \( y \) denotes each interest rate measure in turn. The test of the unit root null in this specification is a test of the null hypothesis that \( \gamma = 0 \). The results are presented in Table A1. For each interest rate measure, we report the test statistic for the unit root null, the \( p \)-value associated with the test statistic, and the number of lagged augmentation terms \( p \) included in the test regression. We cannot reject the unit root null at the 0.05 significance level for any of our interest rate measures.

We then proceeded, under the assumption that our interest rate measures are I(1), to test for cointegration in each of the specifications we report in Tables 3 and 4 of the text for cointegration. To do this, we use the Engle-Granger approach, which involves testing for a unit root in a specification of the form

$$\Delta \hat{u}_t = \gamma \hat{u}_{t-1} + \sum_{i=2}^{p} \beta_i \Delta \hat{u}_{t-i+1} + \epsilon_t,$$

where \( \hat{u} \) denotes the residual from an OLS regression estimating the relevant committee decision-making model. The unit root null in this case is equivalent to the null hypothesis of no cointegration; thus, rejecting a unit root would suggest that the particular combination of variables considered is cointegrated. Because we are not able to conduct these tests when there are gaps in the series, as would be the case in the 63- and 43-observation sub-samples, we report the results for only the 99-observation sample.

Table A2 presents the Engle-Granger cointegration test for each specification in Tables 3 and 4. As in Table A1, we report the test statistic for the unit root null, the \( p \)-value associated with the test statistic, and the number of lagged augmentation terms \( p \) included in the test regression. The results suggest that each combination of interest rate measures is cointegrated. This implies that OLS estimates of our committee decision-making models, with variables expressed in level form, are consistent. However, although coefficient estimates are consistent, standard inference procedures are not appropriate for some of the hypotheses we test. Specifically, with a single I(1) regressor, standard inference procedures are not appropriate for testing the null hypothesis that \( \phi_1 \) equals one, nor are they appropriate for testing the null hypothesis that the coefficients sum to one in specifications in which we have two or more I(1) regressors. In the latter case, though, it is possible to interpret the individual \( t \)-statistics in the usual way; Hamilton (1994, pp. 602-608), Sims, Stock, and Watson (1990), and West (1988) discuss this special case.
Section V. Bootstrapping Methods for Hypothesis Testing

For those specifications in which standard inference procedures are inappropriate, we carry out Monte Carlo simulations to calculate bootstrapped critical values and \( p \)-values associated with our hypothesis tests. We describe our bootstrapping procedures in this section.

Case I. Regressions with a Single Right-Hand-Side Variable

Consider the case of a 1-variable regression:

\[
(A.4) \quad y_{0t} = \beta_0 + \beta_1 y_{1t} + u_t
\]

where we permit serial correlation in \( u_t \):

\[
(A.5) \quad u_t = \rho u_{t-1} + v_t .
\]

Further, \( y_{lt} \) is specified to follow the process:

\[
(A.6) \quad y_{lt} = y_{l_{t-1}} + e_t .
\]

The error terms, \( u_t, v_t, \) and \( e_t \) are normally distributed white-noise disturbances.

To test hypotheses, we first estimate the variances \( \sigma_u \) and \( \sigma_v \). To do so, we impose the null hypothesis that \( \beta_0 = 0 \) and \( \beta_1 = 1 \); an estimate of \( \sigma_u \) can then be obtained as the variance of the residuals in (A.4). Then (A.5) is estimated using the residuals from (A.4), providing estimates of \( \rho \) and \( \sigma_v \). Using data available for \( y_{lt} \), we are able to estimate the variance \( \sigma_e \) from (A.6).

We then begin the bootstrapping procedure. Using the estimated error variances, we draw values for each of the random errors, \( u_t, v_t, \) and \( e_t, \) for a sample of 99 observations (corresponding to our 99-observation data set of FOMC meetings). Using historical data for initial values of \( y_0 \) and \( y_1 \), we then use the process described by (A.4)-(A.6) to generate a 99-observation sample of pseudo-data for each of those two variables. Next, using that sample, we estimate equation (A.4), saving values of the parameter estimates for \( \beta_0 \) and \( \beta_1 \). We then repeat this process (beginning again by drawing values for \( u_t, v_t, \) and \( e_t \)) 10,000 times, obtaining 10,000 sets of coefficients. The \( p \)-values and test results reported for tests of the hypothesis that \( \beta_1 = 1 \) in the first two columns of Table 3 are based on the distribution of coefficient values generated by this procedure.
Case II. Regressions with Multiple Right-Hand-Side Variables

We now consider the case of multiple right-hand-side variables; for illustrative purposes, we assume just two right-hand-side variables:

(A.7) \[ y_{0t} = \beta_0 + \beta_1 y_{1t} + \beta_2 y_{2t} + u_t. \]

The right-hand-side variables, \( y_{1t} \) and \( y_{2t} \), are determined according to:

(A.8a) \[ y_{1t} = \alpha_1 + y_{1*} + e_{1t}, \]

(A.8b) \[ y_{2t} = \alpha_2 + y_{2*} + e_{2t}, \]

where \( y_{1*} \) follows a random walk:

(A.9) \[ y_{1*} = y_{1*_{t-1}} + \epsilon_t. \]

The right-hand-side variables are driven by a common random walk embodied in \( y_{1*} \). Such an assumption is needed to account for the high correlations across right-hand-side variables in the original data. Although \( y_{1*} \) is not directly observed, we can generate pseudo-data for it given an initial value, \( y_{1*_{t=1}} \), and given a variance for \( \epsilon_t \).

We are able to obtain values for the variances of \( e_1 \), \( e_2 \), and \( \epsilon_t \) in the following way. First, note that we can write the processes for \( y_{1t} \) and \( y_{2t} \) as:

(A.10a) \[ y_{1t} = y_{1t_{t-1}} + \omega_{1t}, \]

(A.10b) \[ y_{2t} = y_{2t_{t-1}} + \omega_{2t}, \]

where \( \omega_{1t} = \epsilon_t + e_{1t} - e_{1t_{t-1}} \) and \( \omega_{2t} = \epsilon_t + e_{2t} - e_{2t_{t-1}} \). From residuals for equations (A.10), we can calculate estimates of \( \text{Var}(\omega_{1t}) \), \( \text{Var}(\omega_{2t}) \), and \( \text{Cov}(\omega_{1t}, \omega_{2t}) \). However, we know that

\[ \text{Var}(\omega_{1t}) = \text{Var}(\epsilon_t) + 2\text{Var}(e_{1t}) \]

\[ \text{Var}(\omega_{2t}) = \text{Var}(\epsilon_t) + 2\text{Var}(e_{2t}) \]
### Table A1. Unit Root Test Results

<table>
<thead>
<tr>
<th>Specification</th>
<th>Test Statistic</th>
<th>P-Value</th>
<th>Number of Lagged Augmentation Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>TARGETR</td>
<td>-2.3732</td>
<td>0.149</td>
<td>3</td>
</tr>
<tr>
<td>BURNS</td>
<td>-2.3938</td>
<td>0.143</td>
<td>4</td>
</tr>
<tr>
<td>MEAN</td>
<td>-2.4959</td>
<td>0.116</td>
<td>4</td>
</tr>
<tr>
<td>MEDIAN</td>
<td>-2.5160</td>
<td>0.112</td>
<td>4</td>
</tr>
<tr>
<td>MEANGOV</td>
<td>-2.4032</td>
<td>0.141</td>
<td>4</td>
</tr>
<tr>
<td>MEANBP</td>
<td>-2.5705</td>
<td>0.099</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table A2. Engle-Granger Cointegration Test Results

<table>
<thead>
<tr>
<th>Specification</th>
<th>Test Statistic</th>
<th>P-Value</th>
<th>Number of Lagged Augmentation Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-4.5616</td>
<td>0.000</td>
<td>4</td>
</tr>
<tr>
<td>Median</td>
<td>-5.4620</td>
<td>0.000</td>
<td>4</td>
</tr>
<tr>
<td>Mean with Burns</td>
<td>-4.9366</td>
<td>0.000</td>
<td>4</td>
</tr>
<tr>
<td>Median with Burns</td>
<td>-5.4861</td>
<td>0.000</td>
<td>4</td>
</tr>
<tr>
<td>Presidents and Governors</td>
<td>-4.4516</td>
<td>0.006</td>
<td>4</td>
</tr>
<tr>
<td>Hybrid</td>
<td>-5.3598</td>
<td>0.000</td>
<td>4</td>
</tr>
</tbody>
</table>
Figure A1. Burns Preference and Adopted Target
Figure A2. Committee Mean and Committee Median
Figure A3. Governors’ Mean and Bank Presidents’ Mean