FOOLING SOME OF THE PUBLIC SOME OF THE TIME?
A TEST FOR WEAK RATIONALITY WITH HETEROGENEOUS INFORMATION LEVELS

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Abstract   Past research demonstrates that economic expectations of mass publics are related to political and policy outcomes. However, these studies often assume the public possesses the same information levels and capabilities, and some inappropriately equate a prospective orientation with the ability to make unbiased forecasts. In this article we relax the information-homogeneity assumption and use education level as a proxy for heterogeneity. These heterogeneous education (information) levels are used in a test for unbiased forecasting (i.e., *weak* rational expectations) in inflation expectations data from the Institute of Social Research's Survey of Consumer Attitudes and Behavior. The period of analysis is January 1978 to December 1993. Our descriptive evidence indicates that the members of better-educated strata are more accurate in predicting future movements in actual inflation. The more rigorous tests show that only the most educated exhibit any evidence of weak rational expectations. This suggests that the often contradictory results of past studies may be partly attributable to the information homogeneity assumption. On a broader level, the findings reflect the mass public's varying abilities to hold elected officials accountable.

Political scientists interested in the study of voting behavior and political economy increasingly rely on the role voter expectations play in determining political outcomes (Clarke and Stewart 1994; Kuklinski and West 1981; MacKuen, Erikson, and Stimson 1992; Miller and Wattenberg 1985). Many recent studies focus on how these expectations form and whether they reflect a sophisticated and knowledgeable "forward"-looking electorate *or* a naive and uninformed "backward"-oriented electorate (Haller and Norpoth 1994; Krause 1997; MacKuen, Erikson, and Stimson 1992; Suzuki 1992).

Some now argue that voters are inherently prospective in their economic evaluations (MacKuen, Erikson, and Stimson 1992). Others challenge this "prospective-only" school of thought on purely methodological grounds, suggesting that both retrospective and prospective judgments matter (Clarke and Stewart 1994).

Our study builds on past research in two ways. First, the mass public is viewed as a heterogeneous entity whose information gathering and processing capabilities vary. This is consistent with recent microlevel analyses finding that political knowledge and sophistication are not homogeneous across the public (Delli Carpini and Keeter 1996; McGraw and Pinney 1990, p. 26; Neuman 1986). One factor that can represent heterogeneity is years of formal education (Converse 1964; MacKuen 1984; Nie, Junn, and Stehlik-Berry 1996; Sniderman, Glazer, and Griffin 1990). We implement a test for information heterogeneity by breaking the mass public into three distinct segments of educational attainment.[1]

A second contribution of this article is that a more rigorous method is used to determine whether citizens are systematically wrong in their judgments. We test for a specific form of rational expectations (RE), commonly referred to as *weak* rational expectations (WRE).[2] This type of behavior implies that actors form unbiased expectations regarding future states or conditions. Substantively, WRE behavior reflects not only a prospective or forward-looking orientation, but also goal direction and optimizing behavior (see, e.g., Muth 1961; Sheffrin 1983).

Note that the implication of RE is broader than the resolution of retrospective versus prospective voter orientations (Downs 1957) since RE, in the form discussed here, deals with the ability to avoid systematic mistakes in forecasts. A prospective-voter orientation is one requirement; but RE also requires that the public be able to observe, process, and react to political and economic information. In short, RE deals with the larger

1. The presence of information heterogeneity in many microlevel studies of public opinion and political behavior can be tested (see, e.g., Converse 1990; Lupia 1994; MacKuen 1984; Sniderman, Glazer, and Griffin 1990).
2. With the exception of Haller and Norpoth (1994), other political science investigations of economic expectations formation have not formally tested for rational expectations. The Haller and Norpoth study treats the electorate as a homogeneous entity and does not use conventional statistical inference procedures employed in economics to test this theory.

normative issue of *democratic accountability* more directly than with a finding for a prospective-voter orientation.

To resolve these issues, actual inflation-forecast data are broken down by formal educational attainment. We hypothesize that more educated segments of citizens more accurately forecast actual inflation than do their less educated counterparts. In other words, we expect that the condition of WRE most likely occurs in the well-educated segments of the electorate. We test for WRE using Survey of Consumer Attitudes data on monthly inflation expectations between January 1978 and December 1993.

Weak Rational Expectations: Theory and Hypotheses

Weak rational expectations pertain to an individual's ability to predict correctly on average (see, e.g., Brown and Maital 1981; Muth 1961; Sheffrin 1983). This is less demanding of an individual's or group's information-processing ability than is *strong* rational expectations (SRE), which require the efficient use of all current and available information.[3] While WRE posit that segments of the electorate are able to predict the future in a manner in which mistakes are not systematically made, it by no means implies perfect prediction.

Theoretically, WRE can be represented by the following expression:

$$X_{t+i}^e = E[X_{t+i}|\omega_t], \tag{1}$$

where the prediction for X at time $t + i$ (X_{t+i}^e) equals the expected value of X at time $t + i$, conditional on a subset (ω_t) of all relevant information contained in the information set (Ω_t) at time t. Intuitively, this means that the predictions of X (X_{t+i}^e) on average equal its realizations i periods ahead (X_{t+i}). This property, known as *unbiased forecasting,* implies the following empirical result:

$$E(\xi_{t+i}) = 0. \tag{2}$$

The theoretical mean of the forecast errors $[E(\xi_{t+i})]$ is zero when only using a single expectation variable (X_{t+i}^e) to predict the actual value of X_{t+i}. WRE imply that a given segment of the electorate constructs accurate forecasts on average, even though they fail to consider other relevant information that aids in forecasting X at time $t + i$.[4]

3. SRE are efficient since no other available information can be used to improve a forecast. We explore this issue in another paper (Krause and Granato 1996).
4. The result that expectational errors are zero forecloses the chance of alternative forms of testing. It could be argued that another test could be correctly predicting the direction of change in a variable. However, this test fails since the possibility exists where the prediction is in the same direction, yet the forecaster will never actually *catch up* to the actual values. Systematic prediction error can still occur.

In the context of information heterogeneity, forecasts should not be uniform. As the most highly interested individuals are also the best informed and quickest to process political (or economic) information (Graber 1984; MacKuen 1984), we expect the inflation forecasts of the more educated stratum to exhibit less bias than the forecasts of the less educated strata.

Inflation Expectations: Accountability and Feasibility Constraints

Inflation expectations serve as an important indicator of electorate sophistication at two levels. First, macroeconomic models centered on the RE hypothesis maintain that, although the public's expectations may misdiagnose long-term policy consequences, they cannot be permanently inaccurate. Note the difference between RE and prospectiveness. A prospective orientation can be permanently inaccurate.[5]

An example of this difference can be shown by way of macroeconomic policy initiatives. Consider a policy change that is made to raise aggregate demand (price inflation) and lower unemployment—a short-term Phillips curve trade-off. This policy succeeds if it does not cause the public's long-term inflation expectations to rise. If inflation expectations increase as an accurate reflection of the policy's future consequences, then wage demands soon reflect the higher inflation expectations. This eventually negates the stimulative policy, since the increasing wage demands make labor costs prohibitively high and discourage additional hiring. In the end, the purpose of the policy is defeated since both unemployment and inflation increase to levels that are higher than they were before the policy changes. Under WRE, in contrast, the ability of the public to upgrade their inflation expectations (via wage demands) is faster and more accurate than if they merely possess a prospective orientation.

On another level—the level of democratic accountability—inflation

5. Expectations are inherently prospective since they are forecasts of the future that influence current decisions and behavior. There is a long history of modeling expectations and expectations formation. The interest in rational expectations is merely one of the most recent iterations. The empirical implications of rational expectations are spelled out, in part, in the previous section. The key distinguishing result that makes rational expectations a more appropriate means to test democratic accountability is the unbiased-forecasting result. This means there is no systematic error in forecasts where the public cannot be systematically misled by policy makers, elected officials, or both. However, there are other ways to model expectations and a prospective orientation. For example, Cagan's (1956) *adaptive expectations* model—unlike rational expectations—relies only on the past history of the variable in question to make forecasts. It is well known that this expectations mechanism imparts a systematic bias against correct prediction. Therefore, while it is one of the more modern expectations models, it is not useful for determining democratic accountability since it possesses a built-in bias against correct evaluation of behavior.

expectations are of interest to political scientists because inflation is a phenomenon that is important to voters (see, e.g., Chappell and Suzuki 1993; Peretz 1983). If the public possesses RE, macroeconomic variables of specific interest to incumbents, policy makers, and voters, such as output, unemployment, and business conditions, depend on what happens to inflation expectations (Fischer 1977; Lucas 1972). Consequently, an electorate or mass public exhibiting RE serves as a *feasibility constraint* on the policies undertaken by elected officials (Suzuki and Chappell 1996). An RE public discounts a policy with salutary short-term benefits and punishes (or does not reward) incumbent politicians if the long-term consequences are adverse. This, in turn, has the net effect of limiting the exercise of policy discretion by incumbents. Inflation expectations therefore provide a measurable feasibility constraint on the policy initiatives of incumbent elected officials (Suzuki and Chappell 1996).[6]

Information Heterogeneity

The basic formulation of the RE hypothesis, and its typical modeling in economics, posits homogeneous information across households, firms, or both (see, e.g., Hansen and Sargent 1980). In a similar vein, research examining aggregate economic expectations views the electorate as a singular entity that forms economic expectations with homogeneous information capabilities (e.g., Batchelor and Dua 1989; Haller and Norpoth 1994; MacKuen, Erikson, and Stimson 1992; Rich 1989; Suzuki 1992; Williams 1987).

There is, however, a body of theoretical literature in economics that argues for relaxing the homogeneity assumption (Frydman and Phelps 1983; Pesaran 1987; Radner 1982). Based on this refinement, recent research by Krause (1997) provides empirical evidence that there is a greater reliance on retrospective sources of information as one moves from more to less informed segments of the electorate. This view is consistent with Rivers's (1988) finding that voters are heterogeneous actors who utilize different decision rules.

What is the basis for heterogeneous information levels? Quite simply, the acquisition of information is not a costless endeavor. Research findings suggest that more informed members of the electorate have greater ability to acquire information than do less informed segments (Graber 1984; MacKuen 1984).[7] The most knowledgeable group of individuals on

6. Moreover, this measure yields a more detailed time series on economic expectations because it asks survey respondents for an actual prediction value (rather than an ordinal response).
7. MacKuen (1984, pp. 386–87) finds that (1) citizens' reaction time to changes in media coverage are shaped by skill and motivations associated with information processing and that (2) citizens differ in the speed with which they respond to changes in the elite political

a given subject not only acquires the most information, but are also able to retain more of it than are less knowledgeable segments (Ferejohn 1990, p. 11). In contrast, those segments of the electorate with lower levels of political sophistication often use heuristic devices (i.e., judgmental short-cuts) as a way of becoming more informed (Lupia 1994; Sniderman, Brody, and Tetlock 1991). The upshot is that while aggregate analysis is a fruitful endeavor, it is important to investigate information heterogeneity within the electorate (Converse 1990).

We use formal educational attainment to serve as a proxy for information levels. Some political scientists argue that the information distinction between groups or strata falls along the lines of formal educational attainment because it is strongly related to the ability to behave as a sophisticated actor (e.g., Converse 1964; MacKuen 1984; but see Zaller 1992). Education is also a vital component of citizenship in a democracy because it is positively associated with political and public affairs competence; thus, an argument can be made for using education levels as a proxy for the concept of informational groups (Delli Carpini and Keeter 1996; Nie, Junn, and Stehlik-Berry 1996, p. 37). In other words, formal education can be linked to political sophistication via a *cognitive* channel that enables citizens to enhance their information-processing capabilities and a *network* channel that reflects a socialization process related to formal educational attainment (Converse 1964; MacKuen 1984).

Data: The Measure of Inflation Expectations

The inflation-expectations series is from the Institute for Social Research's (ISR) Survey of Consumer Attitudes and Behavior. This dependent variable is a ratio measure and provides an actual forecast of inflation question, not simply a directional response. From January 1978 to December 1993,[8] the survey question employed is: "By what percent do you expect prices to go (up/down) on the average during the next 12 months?"[9]

This variable is superior to other surveyed "expectation variables"—

environment. In addition, it is possible that more informed portions of the electorate acquire *higher quality* information. We thank John Freeman for bringing this latter point to our attention.
8. Complete information on the samples is available from the Inter-University Consortium for Political and Social Research (ICPSR), where the data are archived. The data are monthly. The available data disaggregated by education level is from January 1978 to December 1993 ($N = 192$).
9. Missing values occurred in the following months: October 1979, July 1987, October 1987, November 1987, and December 1987. We use the interpolation method from Krause (1997, p. 1180 n. 7). For the January 1991 to December 1993 surveys, respondents could answer this question or a question that is nearly identical with the exception that changes in the price level are expressed in "x" cents on the dollar rather than in percentage terms.

retrospective business evaluations, business expectations, unemployment expectations—since each of these alternatives convert ordinal survey responses into a scale. This may be one of the reasons Haller and Norpoth (1994), for example, reject the RE hypothesis. The ordinal response may be confounded by measurement error (Attfield, Demery, and Duck 1991, pp. 41–42; Clarke and Stewart 1994, p. 1120).[10]

Empirical Tests and Findings

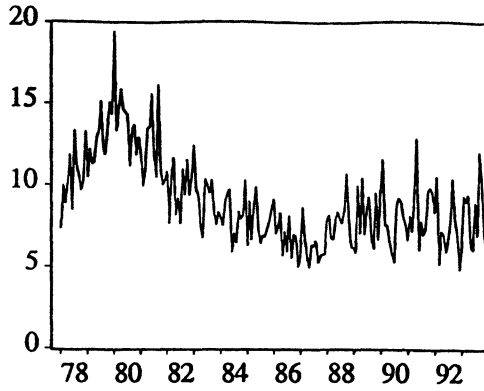### DESCRIPTIVE STATISTICS: INFLATION EXPECTATIONS BY EDUCATION LEVEL

Since education serves as our proxy for heterogeneous information levels, we categorize the inflation-expectation series into the following educational groupings: those respondents with less than a high school diploma or its equivalent (LOW), those who have a high school diploma and those with some college or postsecondary education (MEDIUM), and those respondents who have at least a baccalaureate four-year college degree (HIGH).[11] As a further check on the heterogeneity question, we include a category for all respondents in the sample (AGGREGATE).

Figure 1 presents a graphical analysis of the respective inflation expectations of the three groups.[12] Each group exhibits a similar pattern in that they all start off in the late 1970s as having "peaks" in expectations. These expectations fall in the 1980s, just as actual inflation was falling. The least-educated group (LOW) is more volatile than the other two groups, with the least-volatile group being the highest-educated group (HIGH). The expected negative relationship between education and volatility is borne out by the respective range (minimum to maximum) of predictions for LOW (4.81–19.5), MEDIUM (4.6–14.18), and HIGH (3.81–13.6). The breakdown by education also holds for the forecast errors. The standard deviation follows a similar pattern (LOW = 3.68, MEDIUM = 3.50, HIGH = 3.45).

10. Freeman (1990) argues that researchers should work with data in the sampling interval that most closely matches its natural time interval. Failure to do so leads to results that are contaminated by systematic sampling and temporal aggregation. We employ monthly rather than the temporally aggregated quarterly measures used elsewhere (Clarke and Stewart 1994; Haller and Norpoth 1994; MacKuen, Erikson, and Stimson 1992). This is sensible given that many macroeconomic statistics (including the rate of inflation) are released to the public in monthly intervals.
11. The original data from the Survey of Consumer Attitudes has six educational categories that are ordinal. Although we conduct the entire analysis with these six categories and have similar outcomes, these "uncollapsed" results have much smaller sample sizes for the six individual categories. This induces volatility in the data that is distinct from behavioral patterns we wish to capture.
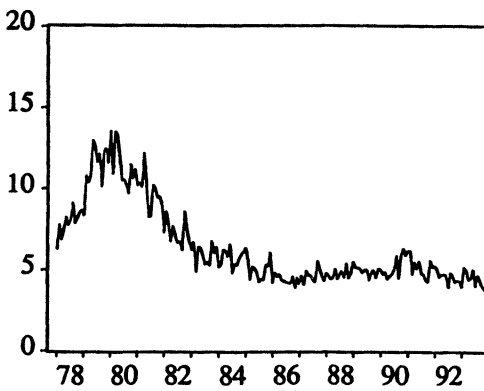12. For each group the respective sample size mean and standard deviation are LOW (54, 19), MEDIUM (244, 53), HIGH (135, 21), and AGGREGATE (433, 86).
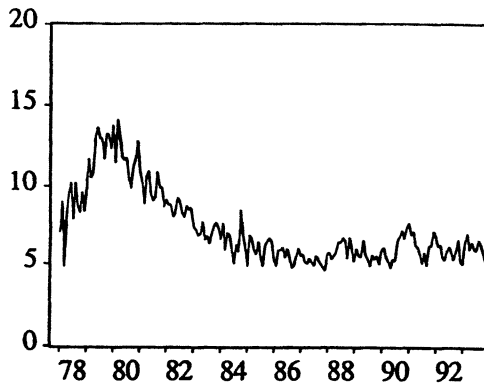
Figure 1. Graphical analysis of surveyed inflation expectations (January 1978 to December 1993).

To better inspect the degree of forecast accuracy (or biasedness) for each group, we employ three separate univariate descriptive forecasting statistics—Mean Absolute Forecast Error (MAFE), Root Mean Square Error (RMSE), and Theil's U^M *bias* coefficient (see table 1). High values for each statistic indicate less accurate prediction.[13]

It is apparent from the mean forecast errors for each group that all strata, on average, overpredict the actual inflation rate. However, the more educated segments of the electorate possess both a smaller mean forecast error and variance. In addition, the mean absolute forecast error and root mean square error are smaller as we move to higher education levels ($MAFE_{LOW} = 4.64$, $MAFE_{MEDIUM} = 3.40$, $MAFE_{HIGH} = 2.80$; $RMSE_{LOW} = 5.51$, $RMSE_{MEDIUM} = 4.21$, $RMSE_{HIGH} = 3.74$). Theil's U^M bias coefficient also indicates higher educational levels contribute to more accurate inflation forecasts. Examination of the disaggregated results shows that, for each higher education level, the systematic mistakes displayed by respondents drops by nearly half ($U_{LOW}^M = .56$, $U_{MEDIUM}^M = .31$, $U_{HIGH}^M = .16$). Not surprisingly, these results indicate that the aggregate homogeneous electorate-data results approximate the moderately educated group ($U_{AGGREGATE}^M = .32$).

EMPIRICAL MODELS OF WEAK RATIONAL EXPECTATIONS

The test for WRE for each educational stratum (j) is of the form:

$$\pi_{t+12} = \alpha_j + \beta_j^* \pi_{j,t}^e + \epsilon_{j,t+12}, \tag{3}$$

where π_{t+12} is the actual inflation rate twelve months ahead and $\pi_{j,t}^e$ is the Survey of Consumer Attitudes forecast for each educational stratum.[14] The WRE hypothesis is supported if $\alpha_j = 0$ and $\beta_j^* = 1$ *jointly cannot be rejected* (Sheffrin 1983, p. 18).[15]

Note that these tests of voter rationality are subject to an overlapping data problem (Hansen and Hodrick 1980). This statistical dilemma refers to a moving average process in the forecast errors that is induced by the measurement intervals of the data set (monthly data) being smaller than the 12-month forecasting horizon used to predict future inflation (Brown

13. Theil's U^M *bias* coefficient is a measure of systematic error that captures the average values of actual and predicted (forecasted) series deviate from one another (Theil 1966, pp. 26–36). See the bottom of table 1 for formulas.
14. While all data have some measurement error, this could especially be true for the surveyed inflation forecast. Since it serves as an independent variable, this introduces the possibility that the error term and this variable are correlated, thereby violating a central assumption of the classical linear model. We test for this possibility by using the Ramsey (1969) RESET. The null hypothesis is that the residuals have a zero mean vector. In all four cases, the null cannot be rejected.
15. This same type of test has been applied by students of international financial economics to determine whether currency exchange markets are efficient (e.g., Baillie, Lippens, and McMahon 1983; Baillie and McMahon 1989; Dornbusch 1976).

Table 1. Descriptive and Univariate Forecasting Statistics for Assessing Predictive Accuracy of Inflation by Education (January 1979–December 1994)

	LOW (No High School Diploma)	MEDIUM (High School Diploma/Some College)	HIGH (Baccalaureate/Graduate Degrees)	AGGREGATE (All Respondents)
Descriptive Statistics:				
Mean Forecast Error	-4.11	-2.35	-1.48	-2.35
Forecast Error Variance	13.53	12.28	11.89	11.69
Minimum Forecast Error	-16.21	-13.12	-12.80	-12.78
Maximum Forecast Error	6.56	7.23	8.67	7.24
Jarque-Bera Test (Normality)	5.69*	6.55**	11.14***	7.78**
$(\chi^2_{[(2),\alpha=.05]} = 5.99)$	(.06)	(.04)	(.00)	(.02)
Univariate Descriptive Forecasting Statistics:				
Mean Absolute Forecast Error	4.64	3.40	2.80	3.33
Root Mean Square Error	5.51	4.21	3.74	4.13
Theil's-U^M (Bias) Coefficient	.56	.31	.16	.32

NOTE.—The sample period accounts for the one-year (twelve-month) ahead forecast of inflation. The values include interpolated values. The mean absolute error statistic is computed as $\sum(|\pi_{t+12} - \pi_t^e|)/n$; the root mean square error statistic is computed as: $\sum(\pi_{t+12} - \pi_t^e)^2/n]^{1/2}$; and the Theil U^M-bias coefficient is computed as: $[(\overline{\pi}_{t+12} - \overline{\pi}_t^e)^2/[\sum(\pi_{t+12} - \pi_t^e)^2*(1/N)]$.

* $p < .10$.
** $p < .05$.
*** $p < .01$.

and Maital 1981). If significant serial correlation problems arise, then the standard errors of the individual coefficients can be corrected with the method proposed by Newey and West (1987; see appendix).

In table 2, the Wald (χ^2) tests for the joint hypothesis test that $\alpha_j = 0$ and $\beta_i^* = 1$ is rejected for the two lowest-educated groups (LOW and MEDIUM) as well as for the electorate as an aggregate, homogeneous entity (AGGREGATE).[16] Interestingly, we do find some evidence WRE can be rejected for *all* educational groups if the significance-level threshold is at the 10-percent level. However, using the 5-percent convention, we do find that the most educated segments of the electorate (HIGH) possess WRE.

In summary, our findings do uncover some notable empirical evidence that the electorate is a heterogeneous entity with different levels of sophistication in forecasting inflation, based on differences in educational attainment. Both the descriptive statistics of the forecast errors and univariate forecasting statistics show strong support for our thesis that more educated segments of the electorate form more accurate inflation forecasts than do their less educated counterparts. Moreover, while the aggregate electorate as a single entity closely resembles the sophistication displayed by the middle educated group, it neglects the variability from those with less than a high school education and those with at least a four-year college degree. Based on the regression-based hypothesis tests for weak rationality, there is only modest support for the information heterogeneity thesis. It is also important, however, to consider that the magnitude of this test statistic declines by an appreciable amount as we move from the least educated (LOW) through the most educated (HIGH) strata. The overall portrait suggests that the degree of inflation-forecast unbiasedness generally declines as we move from less informed (educated) toward more informed (educated) segments of the electorate.

16. We use two alternatives to test for equality between these regression models. One way to do this is to test the equality for the dual hypotheses that $\alpha_j = 0$ and $\beta_j^* = 1$ across educational segments by stacking the individual equations into a system of equations. We cannot reject the null hypothesis that the constants ($\alpha_{LOW} = \alpha_{MEDIUM} = \alpha_{HIGH}$) and slopes ($\beta_{LOW} = \beta_{MEDIUM} = \beta_{HIGH}$), respectively, are equal to each other across each group. The joint hypothesis, however, that assumes that both constants and slopes are equal across each of the three equations ($\alpha_{LOW} = \alpha_{MEDIUM} = \alpha_{HIGH}, = \beta_{LOW} = \beta_{MEDIUM} = \beta_{HIGH}$) is rejected at the 1-percent level. An additional way to test for equality is the likelihood-ratio test. This test is pairwise where: $-2 \times$ (log-likelihood$_1$ − log-likelihood$_2$) $\sim \chi^2_{(1)}$. The null hypothesis is that there are no differences in terms of predictive power. These results show that none of the pairwise groupings are equivalent regression specifications: LOW versus MEDIUM $= 8.04$, $p < .01$; MEDIUM versus HIGH $= 6.54$, $p \approx .02$; and LOW versus HIGH $= 14.58$, $p < .01$.

Table 2. Empirical Tests of "Weak" Rationality by Educational Stratum (January 1979–December 1994)

Coefficient	LOW (No High School Diploma)	MEDIUM (High School Diploma/Some College)	HIGH (Baccalaureate/Graduate Degrees)	AGGREGATE (All Respondents)
Constant	−.71	−.71	−.07	−1.06
	(1.47)[a]	(1.53)	(1.42)	(1.60)
Expected Inflation$_t$	.63***	.78***	.78***	.82***
	(.21)	(.26)	(.29)	(.27)
χ^2 Test ($\alpha = 0$, $\beta = 1$)	33.57***	12.91***	5.40*	15.68***
	(.00)[b]	(.00)	(.07)	(.00)
χ^2 Test ($\alpha_{LOW} = \alpha_{MEDIUM} = \alpha_{HIGH}$)	.49	...	...	...
	(.78)			
χ^2 Test ($\beta_{LOW} = \beta_{MEDIUM} = \beta_{HIGH}$)	1.64	...	...	...
	(.44)			
χ^2 Test ($\alpha_{LOW} = \alpha_{MEDIUM} = \alpha_{HIGH}$, $\beta_{LOW} = \beta_{MEDIUM} = \beta_{HIGH}$)	26.41***	...	...	...
	(.00)			
Adjusted R^2	.18	.21	.24	.25
SEE	3.55	3.47	3.41	3.40
Durbin-Watson Statistic	.73	.69	.70	.70
LM F-test (Lags 1–12)	14.29***	13.93***	13.74***	13.77***
	(.00)	(.00)	(.00)	(.00)
Ramsey RESET (First Order)	.87	1.62	1.93	.06
	(.35)	(.20)	(.17)	(.81)

NOTE.—Significance levels listed inside parentheses are F-tests, unless otherwise noted. Each value is rounded off to the nearest hundredth decimal place. The number of observations in each model is 192. General Equation Form: $\pi_{t+12} = \alpha + \beta^* \pi_t^e + \epsilon_{t+12}$

[a] Newey-West (1987) autocorrelation-consistent standard errors in parentheses.
[b] Probability level of Wald χ^2 tests in parentheses.
* $P < .10$.
** $P < .05$.
*** $P < .01$.

Conclusion

Rather than using indirect means such as prospective-voter orientation to gauge rationality, this research directly tests the RE hypothesis. Using explicit tests for WRE, we examine the manner and degree to which a heterogeneously informed public forms its inflation expectations. Our empirical findings center on *heterogeneous information levels in which education serves as a proxy for information capabilities* and the degree of (*un*)biased predictions concerning future conditions.

   These empirical results demonstrate that past studies of economic expectations by a homogeneous electorate do not capture important differences (e.g., Batchelor and Dua 1989; Figlewski and Wachtel 1981; Haller and Norpoth 1994; MacKuen, Erikson, and Stimson 1992; Suzuki 1992). The findings show that the more educated segments of the mass public do form more accurate forecasts of inflation. In addition, there is moderate evidence that the most-educated segment of the electorate (those with at least a baccalaureate college degree) form inflation forecasts that are not systematically incorrect. Their predictions of inflation, on average, equal their realizations. That is, they form unbiased forecasts of actual inflation one year into the future.

   These same results, however, also show that those citizens with some college training or less education fail to exhibit WRE. This points to a weakness of previous work that relies on the information-homogeneity assumption. While the aggregate *homogeneous* (AGGREGATE) results are strikingly similar to those from moderately educated stratum (MEDIUM), these results will misstate the sophistication of the least- and most-educated segments of the citizenry (see, e.g., Curtin 1980; Gramlich 1983).

   The implications of this research for *democratic accountability* are clear in that our variable of interest can serve as a feasibility constraint on policy makers. Although a feasibility constraint does exist regarding inflation expectations, it is both variable and limited in scope. The reason is this: while the most-educated portion of the mass public cannot be systematically ''fooled'' by incumbent policy makers with respect to inflation, the less educated segments appear to have significant trouble in correctly gauging movements. The fact that the bulk of the public fails the test for WRE raises challenging questions for democratic accountability. However, this does not preclude the possibility that better-educated segments of the electorate, through a variety of communication channels, might ''lead'' the less informed segments to behave in a manner consistent with WRE (Granato and Krause 1998; MacKuen, Erikson, and Stimson 1992, p. 607; Mishkin 1983, pp. 59-60; Townsend 1983).

   These findings point future research in two directions. The first direc-

tion is that heterogeneity should be the general rule of thumb when modeling political (or economic) information levels. Models should be augmented to include this complication with new predictions forthcoming. The second area of investigation is determining, in as direct a manner as possible, how quickly and accurately information is transmitted to and incorporated by a heterogeneously informed public.

Appendix

The Problem of Mismatched Sampling and Forecast Intervals

Tests of rationality based on OLS are sometimes inappropriate because the usual assumptions concerning the residuals are not met. In particular, since the forecast interval is longer than the sampling interval (12 months vs. 1 month), the prediction errors for future periods are serially correlated. For example, in this analysis the estimated error for the 1978:1 forecast of 1979:1 involves a 12-month period of uncertainty, but when we estimate 1978:2's prediction for 1979:2, we have an 11-month overlap in "error" or uncertainty that is very likely to be similar to the 1978:1 forecast uncertainty. It is this overlapping uncertainty that presents the serial correlation problem.

We use Hansen and Hodrick's (1980) method of moments with the correction of Newey and West (1987). This ensures that the variance-covariance matrix is positive definite by discounting the rth order autocovariance. Ordinarily, such weighting procedures should be discouraged since they encourage model "patching" (Hendry 1995), but the problem here is data driven.

The Newey and West procedure creates an asymptotically consistent covariance matrix that equals $(X'X)^{-1} X'\Omega X (X'X)^{-1}$, where X is the matrix of regressors (192 observations in this sample; k = 2 predictors [α, β*]), and Ω is the adjusted covariance matrix of the residuals (u_t) equal to:

$$\left[\sum_{t=1}^{T} u_t^2 x_t x_t' + \sum_{p=1}^{q} \left\{ 1 - \frac{p}{q+1} \right\} \sum_{t=p+1}^{T} (x_t u_t u_{t-p} x_{t-p}' + x_{t-p} u_{t-p} u_t x_t') \right]. \quad \text{(A1)}$$

The Newey-West estimator uses a finite number of lags of autocorrelations to approximate residual (u_t) dynamics. In the case where there is no a priori "theory" on the appropriate lag length to be specified in the covariance matrix correction, a common strategy is to truncate the number of lags in the following way. Let the $(i, j)th$ element of Ω, denoted with $\lambda(i, j)$, equal zero except when $p \leq q$, where $p = |i - j|$ and q is the order of the moving average process of the residuals. If $p \leq q$, $\lambda(i, j) = [1 - p/(q + 1)]u_i u_j$. The general rule to follow is $q = 4 \, (^{7}/_{100})^{.22}$, which in this case is equal to $4(^{192}/_{100})^{.22}$ or approximately 5.

However, we know a priori the length of the number of autocorrelations to be 11, since there is a 12-month forecast interval but up to 11 overlapping months of forecast uncertainty. Therefore, we choose $q = 11$.

References

Attfield, Clifford L. F., David Demery, and Nigel W. Duck. 1991. *Rational Expectations in Macroeconomics: An Introduction to Theory and Evidence.* 2d ed. Oxford: Basil Blackwell.

Baillie, Richard T., Robert E. Lippens, and Patrick C. McMahon. 1983. "Testing Rational Expectations and Efficiency in the Foreign Exchange Market." *Econometrica* 51:553–63.

Baillie, Richard T., and Patrick C. McMahon. 1989. *The Foreign Exchange Market: Theory and Econometric Evidence.* New York: Cambridge University Press.

Batchelor, Roy, and Pami Dua. 1989. "Household versus Economist Forecasts of Inflation: A Reassessment." *Journal of Money, Credit, and Banking* 21:252–57.

Brown, Byron W., and Shlomo Maital. 1981. "What Do Economists Know? An Empirical Study of Experts' Expectations." *Econometrica* 49:491–504.

Cagan, Phillip. 1956. "The Monetary Dynamics of Hyperinflation." In *Studies in the Quantity Theory of Money,* ed. Milton Friedman. Chicago: University of Chicago Press.

Chappell, Henry, Jr., and Motoshi Suzuki. 1993. "Aggregate Vote Functions for Presidential, Senate, and House Elections." *Journal of Politics* 55:207–17.

Clarke, Harold D., and Marianne C. Stewart. 1994. "Prospections, Retrospections, and Rationality: The 'Bankers' Model of Presidential Approval Reconsidered." *American Journal of Political Science* 38:1104–23.

Converse, Philip E. 1964. "The Nature of Mass Belief Systems in Mass Publics." In *Ideology and Discontent,* ed. David Apter. New York: Free Press.

———. 1990. "Popular Representation and the Distribution of Information." In *Information and Democratic Processes,* ed. John A. Ferejohn and James J. Kuklinski. Urbana: University of Illinois Press.

Curtin, Richard. 1980. "Consumer Perceptions of Inflation and Expectations." Working paper, University of Michigan, Institute for Social Research.

Delli Carpini, Michael X., and Scott Keeter. 1996. *What Americans Know about Politics and Why It Matters.* New Haven, CT: Yale University Press.

Dornbusch, Rudiger. 1976. "Expectations and Exchange Rate Dynamics." *Journal of Political Economy* 84:1161–176.

Downs, Anthony. 1957. *An Economic Theory of Democracy.* New York: Harper & Row.

Ferejohn, John A. 1990. "Information and the Electoral Process." In *Information and Democratic Processes,* ed. John A. Ferejohn and James H. Kuklinski. Urbana: University of Illinois Press.

Figlewski, Stephen, and Paul Wachtel. 1981. "The Formation of Inflationary Expectations." *Review of Economics and Statistics* 63:1–10.

Fischer, Stanley. 1977. "Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule." *Journal of Political Economy* 85:191–205.

Freeman, John R. 1990. "Systematic Sampling, Temporal Aggregation, and the Study of Political Relationships." *Political Analysis* 1:61–98.

Frydman, Roman, and Edmund S. Phelps, eds. 1983. *Individual Forecasting and Aggregate Outcomes: 'Rational Expectations' Examined.* New York: Cambridge University Press.

Graber, Doris. 1984. *Processing the News: How People Tame the Information Tide.* New York: Longman.

Gramlich, Edward. 1983. "Models of Inflation Expectations Formation: A Comparison of Household and Economic Forecasts." *Journal of Money, Credit, and Banking* 15: 155–73.

Granato, Jim, and George A. Krause. 1998. "Information Diffusion within the Electorate: The Asymmetric Transmission of Political-Economic Information." Political Institutions and Public Choice (PIPC) Working Paper no. 98-01, Michigan State University.

Haller, H. Brandon, and Helmut Norpoth. 1994. "Let the Good Times Roll: The

Economic Expectations of U.S. Voters." *American Journal of Political Science* 38: 625–50.

Hansen, Lars P., and Robert J. Hodrick. 1980. "Forward Exchange Rates as Optimal Predictors of Future Spot Rates: An Econometric Analysis." *Journal of Political Economy* 88:829–53.

Hansen, Lars P., and Thomas J. Sargent. 1980. "Formulating and Estimating Dynamic Linear Rational Expectations." *Journal of Economic Dynamics and Control* 2:7–46.

Hendry, David. 1995. *Dynamic Econometrics.* New York: Oxford University Press.

Krause, George A. 1997. "Voters, Information Heterogeneity, and the Dynamics of Aggregate Economic Expectations." *American Journal of Political Science* 41:1170–1200.

Krause, George A. and Jim Granato. 1996. "Rational Expectations within the Electorate: Formal Tests with Heterogeneous Agents." Paper presented at the annual meeting of the Midwest Political Science Association, Chicago.

Kuklinski, James J., and Darrell M. West. 1981. "Economic Expectations and Voting Behavior in United States House and Senate Elections." *American Political Science Review* 75:436–47.

Lucas, Robert E., Jr. 1972. "Expectations and the Neutrality of Money." *Journal of Economic Theory* 4:103–24.

Lupia, Arthur. 1994. "Shortcuts versus Encyclopedias: Information and Voting Behavior in California Insurance Reform Elections." *American Political Science Review* 88:63–76.

MacKuen, Michael B. 1984. "Exposure to Information, Belief Integration, and Individual Responsiveness to Agenda Change." *American Political Science Review* 78:372–91.

MacKuen, Michael B., Robert S. Erikson, and James A. Stimson. 1992. "Peasants or Bankers?: The American Electorate and the U.S. Economy." *American Political Science Review* 86:597–611.

McGraw, Kathleen M., and Neil Pinney. 1990. "The Effects of General and Domain-Specific Expertise on Political Memory and Judgment." *Social Cognition* 8:9–30.

Miller, Arthur H., and Martin P. Wattenberg. 1985. "Throwing the Rascals Out: Policy Performance Evaluations of Presidential Candidates, 1952–1980." *American Political Science Review* 79:359–72.

Mishkin, Frederic S. 1983. *A Rational Expectations Approach to Macroeconomics.* Chicago: University of Chicago Press.

Muth, John. 1961. "Rational Expectations and the Theory of Price Movements." *Econometrica* 29:315–35.

Neuman, W. Russell. 1986. *The Paradox of Mass Politics: Knowledge and Opinion in the American Electorate.* Cambridge, MA: Harvard University Press.

Newey, Whitney K., and Kenneth D. West. 1987. "A Simple, Positive Semi-Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica* 55:703–8.

Nie, Norman H., Jane Junn, and Kenneth Stehlik-Berry. 1996. *Education and Democratic Citizenship in America.* Chicago: University of Chicago Press.

Peretz, Paul. 1983. *The Political Economy of Inflation.* Chicago: University of Chicago Press.

Pesaram, M. Hashem. 1987. *The Limits to Rational Expectations.* Oxford: Basil Blackwell.

Radner, Roy. 1982. "Equilibrium under Uncertainty." In *Individual Forecasting and Aggregate Outcomes: "Rational Expectations" Reexamined,* ed. R. Frydman and Edmund S. Phelps. Cambridge: Cambridge University Press.

Ramsey, James. 1969. "Tests for Specification Errors in Classical Linear Least Squares Regression Analysis." *Journal of the Royal Statistical Society* Ser. B 31:350–71.

Rich, Robert. 1989. "Testing the Rationality of Inflation Forecasts from Survey Data: Another Look at the SRC Expected Price Change Data." *Review of Economics and Statistics* 71:682–86.

Rivers, Douglas. 1988. "Heterogeneity in Models of Electoral Choice." *American Journal of Political Science* 32:737–57.

Sniderman, Paul M., Richard A. Brody, and Philip E. Tetlock. 1991. *Reasoning and Choice; Explorations in Political Psychology.* Cambridge: Cambridge University Press.

Sheffrin, Steven M. 1983. *Rational Expectations.* Cambridge: Cambridge University Press.

Sniderman, Paul, James Glazer, and Robert Griffin. 1990. "Information and Electoral Choice." In *Information and Democratic Processes,* ed. John A. Ferejohn and James J. Kuklinski. Urbana: University of Illinois Press.

Suzuki, Motoshi. 1992. "Political Business Cycles in the Public Mind." *American Political Science Review* 86:989–96.

Suzuki, Motoshi, and Henry Chappell. 1996. "The Rationality of Economic Voting Revisited." *Journal of Politics* 58:224–36.

Theil, Henri. 1966. *Applied Economic Forecasting.* Amsterdam: North-Holland.

Townsend, Robert. 1983. "Forecasting the Forecasts of Others." *Journal of Political Economy* 91:546–88.

Williams, Arlington. 1987. "The Formation of Price Forecasts in Experimental Markets." *Journal of Money, Credit, and Banking* 19:1–18.

Zaller, John R. 1992. *The Nature and Origins of Mass Opinion.* Cambridge: Cambridge University Press.