



ECONOMIC RESEARCH
FEDERAL RESERVE BANK OF ST. LOUIS
WORKING PAPER SERIES

**On the Rationality of Inflation Forecasts: A New Look at the
Livingston Data**

Authors	R. W. Hafer, and David H. Resler
Working Paper Number	1981-002A
Creation Date	January 1981
Citable Link	https://doi.org/10.20955/wp.1981.002
Suggested Citation	Hafer, R.W., Resler, D.H., 1981; On the Rationality of Inflation Forecasts: A New Look at the Livingston Data, Federal Reserve Bank of St. Louis Working Paper 1981-002. URL https://doi.org/10.20955/wp.1981.002

Federal Reserve Bank of St. Louis, Research Division, P.O. Box 442, St. Louis, MO 63166

The views expressed in this paper are those of the author(s) and do not necessarily reflect the views of the Federal Reserve System, the Board of Governors, or the regional Federal Reserve Banks. Federal Reserve Bank of St. Louis Working Papers are preliminary materials circulated to stimulate discussion and critical comment.

ON THE RATIONALITY OF INFLATION FORECASTS:
A NEW LOOK AT THE LIVINGSTON DATA

by
R.W. Hafer* and David H. Resler**

Federal Reserve Bank of St. Louis

81-002

*Economist, Federal Reserve Bank of St. Louis.

**Economist, First National Bank of Chicago. The views expressed are those of the authors and may not represent those of the Federal Reserve Bank of St. Louis or the First National Bank of Chicago.

Preliminary: Not for quotation without author's permission. Comments welcome.

ON THE RATIONALITY OF INFLATION FORECASTS:
A NEW LOOK AT THE LIVINGSTON DATA

I. Introduction

Recently, a number of scholars have reported results of investigations into the rationality of inflation expectations based on survey data. Data derived from Joseph Livingston's survey of economists have been particularly prominent as a basis for these studies. Investigations of the Livingston survey data have centered on two critical issues. The first concerns the process by which these expectations are formed. The second deals with the more fundamental issue of whether such directly observed expectations, however they may be formed, conform to the Muthian criteria of rationality.^{1,2/}

This study presents new evidence relating to the second question by evaluating the rationality of the inflation expectations formed by economists who can be distinguished by their professional affiliations. This approach differs from those employed in similar studies which simply used the consensus forecasts across professional affiliations. The motivation for examining the different groups is that information and incentives

may differ among individual respondents and that these differences should be identifiable from the economists' affiliations.

The remainder of the paper is presented as follows. Section II examines some problems inherent in forecast data gathered through the survey method. Section III discusses the expectations data and the groupings used in this paper. Section IV presents the rationality tests employed in this paper, along with the relevant empirical results obtained for the various affiliations. Section V offers some concluding observations.

II. Measuring Expectations by Survey

Perhaps the most appropriate way of measuring expectations about certain economic phenomena is to sample public opinion by employing some survey technique. While such public opinion polls are commonly used in other social sciences, they are less frequently employed in economics for a number of reasons. First, public opinion surveys are costly to conduct. These cost considerations may be a more important barrier in economic research since economic theory generally highlights only a fairly narrow set of phenomena about which expectations are important. If the survey method is used to extract only a narrow set of data, scale economies of sampling procedures may not be as exploitable as they are in surveys that ask each respondent a wider variety of questions.

A second factor limiting to the use of survey methods is the availability of less costly substitute procedures. Because theory and empirical evidence suggest that economic phenomena (such as inflation) can be closely approximated by inference from the past time series of that variable, econometric methods that efficiently utilize the information in these time series have become the most commonly used means of approximating expectations.

A third reason for possibly eschewing the survey method relates to the reliability of the survey responses. There are two dimensions to this reliability problem. First, economic theory typically calls for the use of the "market's" expectations. Thus, only the expectations of those participating either directly or indirectly in the market should be considered appropriate.^{3/} Second, even if all respondents are determined to be actual or potential market participants, they may not have sufficient incentive to provide their most accurate forecast. It is puzzling that in a profession in which marginal costs and benefits serve as the cornerstone of analysis, so little attention has been devoted to this aspect of the reliability problem. Because many forecasters may have little to gain (or lose) directly by forming their expectations carefully, their survey responses may represent haphazard guesses rather than thoughtful inflation forecasts. Indeed, an economist's approach to such survey questionnaires (perhaps more than anyone else's) should be expected to depend upon

his/her own assessment of the expected returns from and the costs of supplying a response.

Despite these shortcomings, the usefulness of survey methods in determining inflation expectations may be even broader if some of these reliability problems can be resolved.^{4/} It is argued here that the failure of the Livingston data to conform to specific "rationality" criteria can be explained partly by some aspects of the reliability problem. By separating the consensus forecasts into independent forecasts by economists from different professional affiliations, some of these reliability problems may be overcome. The goal of this paper, then, is to investigate the rationality of the Livingston forecasts when the inflation forecast data is categorized by the respondent's professional affiliation.

III. Data

Carlson (1977) detailed the procedures used by Livingston in his surveys of economists from various professional affiliations. Fortunately, Livingston has maintained detailed records of his biannual survey and has retained all the survey questionnaires. Because these questionnaires identify both the individual economists and their affiliations, they can be used to differentiate the survey responses based on professional affiliation. Forecast averages from each of several such "groups" are then used to examine the rationality hypothesis. Because

economists within some groups have greater incentive to formulate accurate forecasts, their expectations will be more likely to exhibit key characteristics of rationality--viz., forecast efficiency and consistency.

The economists participating in Livingston's survey can be identified with one of six professional affiliations: (1) non-financial businesses; (2) academic institutions; (3) commercial banks; (4) investment banks; (5) the Federal Reserve System; and (6) unspecified (the respondent's mailing address was his home). It seems reasonable to expect that the participating economists are subject to a variety of incentives to form accurate forecasts depending on the nature of their professional responsibilities. For instance, although the academic economists surveyed are at least casually interested in near-term economic forecasting, their primary responsibilities involve teaching and research. Business economists, on the other hand, frequently are called upon to provide their employer with specific economic forecasts. Because their livelihood depends, in part, on their employers' perception of the accuracy of their forecasts, they undoubtedly have a stronger incentive to gather and process more information in the forecasting process than do their academic counterparts. Thus, business economists' inflation forecasts might be expected to adhere more closely than those of academic economists to the criteria of "rationality".

It is important to keep in mind that this line of reasoning does not imply that only economists who are appropriately compensated will form "rational" expectations. Rather, the forecasts of some economists may appear to systematically ignore relevant information available at the time of the forecast. The criteria of rationality that specifies that the forecast error is not systematically related to currently available information implies either that information is costlessly available to all forecasters or that all forecasters have the same incentives to predict accurately. Nevertheless, the subset of economists who have a stronger incentive to form accurate forecasts should exhibit behavior that is consistent with the criteria that they efficiently (in an economic sense) utilize available information.

The next section outlines the formal test of the hypothesis that some groups of economists exhibit forecast rationality. Empirical results from conducting these tests are also discussed.

IV. Tests for Rationality

Rational expectations according to Muth (1961) holds that predictions of the future inflation rate are formed in a manner that fully reflects all relevant information currently available. Stated slightly differently, rational expectations requires that predictions about the future evolution of an economic

variable are formed by the same process that generates the forecasted variable. To test this concept of rationality, Pesando (1975) assumes that the relevant information set upon which inflation expectations are formed is the observed history of inflation.^{5/}

Pesando utilizes the following equations to examine both the efficiency and consistency of the Livingston consensus forecast:

$$(1) \quad P_t = B_1 P_{t-1} + \dots + B_n P_{t-n} + u_{1t},$$

$$(2) \quad {}_t P_{t-1}^* = B_1' P_{t-1} + B_2' P_{t-2} + \dots + B_n' P_{t-n} + u_{2t},$$

and

$$(3) \quad {}_t P_{t-2}^* = B_1'' ({}_{t-1} P_{t-2}^*) + B_2'' P_{t-2} \\ + \dots + B_n'' P_{t-n} + u_{3t}$$

where P_{t-i} ($i=0,1,\dots,n$) represents the actual rate of

inflation, ${}_t P_{t-1}^*$ is the expectation of the current

period (t) rate of inflation made last period (t-1),

${}_t P_{t-2}^*$ is the expectation of the current inflation rate made

two periods ago (t-2), and u_{jt} ($j=1,2,3$) are independent and identically distributed error terms.

Pesando and Carlson (1977) employ the Chow-test to test for the efficiency of the forecasts.

If the constraint that $B_i = B_i'$ for all i cannot be rejected, then the process determining the actual rate of inflation

may be viewed as determining the expectations formation process, too. The consistency test used by Pesando and Carlson requires that $B_i' = B_i''$ for all i , which is also examined using the Chow-test. As Carlson noted, the consistency test requires that "the expected rate of inflation that was forecast 6 months earlier to hold over the next six months must be the same function but with π_{t-1} [P_{t-1} in our notation] replaced by its forecasted value at time $t-1$."^{6/} Full rationality necessitates that the efficiency and consistency criteria be satisfied jointly.

Mullineaux (1978) shows that the Chow-test employed by Pesando and Carlson is improper because the error variances among equations (1) - (3) are not homogeneous. Mullineaux suggests an alternative efficiency test that does not require homogeneity among error variances of the equations (although independence is still necessary). Mullineaux's efficiency test requires that equation (2) be subtracted from equation (1). This gives

$$(4) (P_t - P_{t-1}^*) = (B_1 - B_1') P_{t-1} (B_2 - B_2') P_{t-2} + \dots + (B_n - B_n') P_{t-n} + (u_{1t} - u_{2t}) .$$

Efficiency corresponds to the null hypothesis that

$B_i = B_i'$ for all i ($i=1, \dots, n$). Estimating equation (4) using ordinary least squares, the F-statistic pertinent to

the hypothesis that all coefficients ($\hat{b}_i = (B_i - B_i')$) of equation (4) are zero provides the basis for the efficiency test. In addition, a further requirement for efficiency is that the estimated error structure does not exhibit significant autocorrelation.^{7/}

Mullineaux suggests the following procedure to test for consistency among the inflation forecasts. Subtracting equation (3) from equation (2) and imposing

the constraint that $B_i' = B_i''$ for all i yields

$$(5) \quad (t^{P*}_{t-1} - t^{P*}_{t-2}) = B_i' (P_{t-1} - t^{-1}P^*_{t-2}) + (u_{2t} - u_{3t}).$$

This relationship is estimated and compared with the equation

$$(6) \quad (t^{P*}_{t-1} - t^{P*}_{t-2}) = B_1' P_{t-1} + B_1'' t^{-1} P^*_{t-2} \\ (B_2' - B_2'') P_{t-2} + \dots + (B_n' - B_n'') P_{t-n} + (u_{2t} - u_{3t})$$

in which the constraint that $B_i' = B_i''$ for all i is relaxed.

The test for consistency, then, involves estimating equations (5) and (6) and applying an F-test for the restrictions on the estimated parameters; i.e., that

$$B_1' = B_1'' \text{ and } B_i' = B_i'' = 0 \text{ for all } i \neq 1.$$

Equations (4) through (6) are used in the following empirical investigation of the rationality of the "group" forecasts. Consequently, the inflation forecast variables in equations (4) through (6) are treated as group-specific expectations. Equations (4) through (6) are estimated and the necessary tests are

performed for each of the six affiliations. To facilitate a comparison with previous research that examined only the consensus forecasts, the following sample periods are employed: 1959-1969, 1959-1978, and 1959-1978 excluding the 1971-1973 price control years.

a. The Efficiency Test

Table 1 presents the efficiency test results for each affiliation. The reported F-values, based on ordinary least squares estimates of equation (4), are pertinent to testing the joint hypothesis that $\hat{b}_i (=B_i - B_i') = 0$ for all i . Table 1 also reports the Durbin-h statistics to test for the presence of autocorrelation.

The 1959-1969 sample period results indicate that the null hypothesis of efficiency is rejected at the five percent significance level for the forecasts of academic economists, economists employed at commercial banks, investment bank economists, and those falling into the unspecified category.^{9/} Of the six different affiliations examined, only the forecasts of economists employed by non-financial businesses and the Federal Reserve System exhibited the characteristics of efficiency during this sample period. In addition, the values of the h-statistic allow rejection of the null hypothesis of autocorrelation at the five percent level (two-tailed test) for each group.

The efficiency hypothesis is rejected at higher significance levels and in more instances when the full 1959-1978 sample period is used. For example, the null hypothesis of efficiency is rejected at the one percent level for economists employed at academic institutions, commercial banks, investment banks, and within the Federal Reserve System. The Durbin-h statistics reported for the academic economists and those employed at investment banks also indicate substantial autocorrelation in the residuals. During the 1959-1978 sample period, however, the efficiency hypothesis again cannot be rejected for the forecasts made by economists employed by the non-financial business community. As in the 1959-1969 sample, the calculated F-value for this group, as well as the reported Durbin-h statistic, indicates that these economists efficiently processed the information contained in the history of inflation.

Finally, the efficiency hypothesis for the different groups is tested over the sample period 1959-1978 excluding the price control years. Except for the non-financial business and "unspecified" economists, the F-values reported in table 1 allow us to reject the efficiency hypothesis at the five percent (though not at the one percent) level in every case. Although the calculated F-value for the "unspecified" group of economists is less than the critical five percent F-value ($=2.57$), the Durbin-h statistic indicates that the null

hypothesis of zero autocorrelation may be rejected at the five percent level.^{10/} Thus, for the group with no specified affiliation, the efficiency test results for the 1959-1978 sample period excluding the price control years are somewhat ambiguous. Regardless of sample period chosen, only the group of economists employed by non-financial businesses appear to have efficiently processed the information contained in past inflation. This finding contrasts sharply with previous research showing that the Livingston inflation expectations series fails to satisfy the efficiency criteria.

b. The Consistency Test

The consistency test of the groups' inflation forecasts relies on the OLS estimation of equations (5) and (6). To test for consistency, equation (5) is estimated, and then the constraints that

$\hat{b}_i' = \hat{b}_i''$ for all i are relaxed by estimating equation (6).

The two equations are then compared by means of an F-test. To reject the null hypothesis of consistency, calculated F-values must exceed some critical value. The relevant F-values comparing equations (5) and (6) for each affiliation and time period are reported in table 2.

These F-statistics indicate that, on the whole, economists within each group tend to form expectations of future inflation in a consistent manner. Indeed, in only three out of eighteen cases reported is the hypothesis of

consistency rejected at the five percent significance level. Specifically, the hypothesis is rejected for academic economists in the 1959-1969 sample period, and for Federal Reserve economists during both 1959-1978 sample periods.

Based on the efficiency and consistency test results, it appears that the forecasts of only one group --those employed by non-financial businesses-- unambiguously satisfy the criteria for rationality (i.e., efficiency and consistency). Irrespective of the sample period, this group's inflation forecasts efficiently and consistently utilize the information contained in realized inflation rates. Regarding the other groups examined, in no case does another group meet the criteria of both efficiency and consistency in the same period--a result due primarily to the failure of most groups to satisfy the efficiency criterion of rationality.

One important question remains, however: Why should non-financial business economists consistently provide rational inflation forecasts while others, most notably those who are also employed to provide forecasts (investment and commercial bank economists), fail to do so? Because economic theory suggests that the behavior of market interest rates is closely related to expectations about future inflation, why have the economists closely affiliated with the financial markets fared so poorly? One possible explanation for the

success of the non-financial business economists in rationally predicting inflation derives from their unique position as employees of firms directly involved in the production (and pricing) of goods and services. Consequently, they are strategically placed to observe fluctuations in raw materials prices and production costs, vis-a-vis other economists. If they have "better" information about the future path of their own industry's prices and the group represents a partial cross section of the industries making up the components of the CPI, this group may have the relevant information and incentives to provide more accurate CPI inflation predictions.

V. Conclusions

Previous rationality tests of the Livingston expectations data have overlooked relevant data by disregarding divergent incentives faced by the survey respondents. Economists from different professional affiliations have diverse incentives to accumulate and process information in making their forecasts. Based on this a priori reasoning, this paper presents evidence indicating that, while most affiliation groupings do not satisfy all criteria of rationality, economists within one category--those employed by non-financial businesses--meet the full requirements of rationality (i.e., efficiency and consistency) during the different time periods examined.

An extension of this work would be to examine the rationality of the individual economists in the non-financial business category, perhaps along the lines of Figlewski and Wachtel (1980). In addition, further research could investigate the rationality of other Livingston forecast data (e.g., stock prices or GNP). Although the number of studies devoted to inflation expectations indicates its importance in economic theory, a better understanding of the expectations formation process may come from a broader examination of the various economic variables Livingston asks respondents to predict. Research along these lines is currently being undertaken.

REFERENCES

- Carlson, John A. "Are Price Expectations Normally Distributed?"
Journal of the American Statistical Association, 70(December 1975),
pp. 749-754.
- Carlson, John A. "A Study of Price Forecasts," Annal of Economics and
Social Measurement, (June 1977), pp. 27-56.
- Durbin, J. "Testing for Serial Correlation in Least Squares Regression
When Some of the Regressors are Lagged Dependent Variables,"
Econometrica, (May 1970), pp. 410-21.
- Fama, Eugene F. "Efficient Capital Markets: A Review of Theory and
Empirical Work," Journal of Finance, 25 (May 1970), pp. 383-417.
- Figlewski, Stephen, and Wachtel, Paul "The Formation of Inflationary
Expectations," Review of Economics and Statistics (forthcoming.)
- Hafer, R.W., and Resler, David H. "The 'Rationality' of Survey Based
Inflation Forecasts," Federal Reserve Bank of St. Louis Review,
(November 1980), pp. 3-11.
- Jacobs, Rodney L., and Jones, Robert A. "Price Expectations in the
United States: 1947-1975," American Economic Review, 70 (June
1980), pp. 269-277.
- Kane, Edward J. and Malkiel, Burton G. "Autoregressive and
Nonautoregressive Elements in Cross-Section Forecasts of
Inflation," Econometrica, 44 (January 1976), pp. 1-16.
- Mullineaux, Donald J. "On Testing for Rationality: Another Look at
the Livingston Price Expectations Data," Journal of Political
Economy, 86, (April 1978), pp. 329-336.
- Mullineaux, Donald J., "Inflation Expectations and Money Growth in the
United States," American Economic Review, (March 1980), pp. 149-61.

- Muth, John F. "Rational Expectations and the Theory of Price Movement," Econometrica, (July 1961), pp. 313-35.
- Pearce, Douglas K. "Comparing Survey and Rational Measures of Expected Inflation: Forecast Performance and Interest Rate Effects," Journal of Money, Credit, and Banking, 11 (November 1979), pp. 447-456.
- Pesando, James E. "A Note on the Rationality of the Livingston Price Expectations Data," Journal of Political Economy, (August 1975), pp. 849-58.
- Resler, David H. "The Formation of Inflation Expectations," Federal Reserve Bank of St. Louis Review, (April 1980), pp. 2-12.
- Turnovsky, Stephen J. "Empirical Evidence on the Formation of Price Expectations," Journal of the American Statistical Association, December 1975, pp. 1441-54.
- Wachtel, Paul "Survey Measures of Expected Inflation and Their Potential Usefulness," in Joel Popkin, ed. Analysis of Inflation 1965-1974, National Bureau of Economic Research Studies in Income and Wealth, Vol. 42, Cambridge 1977.

FOOTNOTES

- 1/ For examples of such studies see Turnovsky (1970), Mullineaux (1980), Resler (1980), and Figlewski and Wachtel (forthcoming 1980).
- 2/ See for example Pesando (1975), Carlson (1977), and Mullineaux (1978).
- 3/ Kane and Malkiel (1976) have challenged the use of Livingston survey data, suggesting that the Livingston "forecasts may depart significantly from the 'market' forecasts implicit in contemporaneous interest rates...because the respondents...were not simultaneously active participants in the debt markets." (p.2).
- 4/ This discussion highlights two major themes. The first underscores the necessity of identifying the market's expectations. Since the focus here is on the rate of inflation in a general index of prices (the CPI), it may be appropriate to sample the expectations of the general population. If the focus were instead on the relationship between inflation expectations and interest rates, the objection raised by Kane and Malkiel (see footnote 3) would suggest the desirability of choosing a much narrower sample. Although this distinction of the appropriate market expectation is not central to this study, some of the findings reported here may prove useful to other studies in which this problem is more important.

The second theme emphasizes that the respondents are not provided any direct incentive to form accurate forecasts. This may not represent as serious a problem as it might seem, however. The reason is that many forecasters have an indirect incentive to provide accurate forecasts. Since Livingston surveys only professional economists, it seems likely that many, perhaps most, of the survey respondents are routinely involved in forecasting various economic events for their

employers. Thus the easiest strategy for them to use in responding to Livingston's questionnaire would simply be to record the forecasts they have already made. Consequently, even though Livingston does not provide the respondents with any direct incentive to provide accurate forecasts, their employers may. Nevertheless, it seems likely that these incentives will vary from forecaster to forecaster depending upon the nature and scope of his forecasting responsibilities to his employer. It would seem desirable, then, to screen the respondents in some way to isolate those with the greatest incentive to form accurate forecasts.

5/ This assumption categorizes his test (and our's) as a "weak form" test of rationality. It is argued, however, that rejection of "weak form" rationality directly implies rejection of "strong form" rationality. For a discussion of these tests, see Pesando (1975), Fama (1970), and Rutledge (1974).

6/ Carlson (1977), p. 47

7/ For a criticism of the procedure used by Mullineaux in calculating the forecast errors see Hafer and Resler (1980).

8/ Following Mullineaux (1978), each equation was estimated with a constant term.

9/ The null hypothesis can be rejected also at the one percent level for economists employed at commercial banks.

10/ The Durbin-Watson (D.W.) statistic for this group falls within the indeterminate range. If the estimated form of equation (4) is interpreted as not containing a lagged dependent variable, however, the D.W. is appropriate.

TABLE 1
EFFICIENCY TEST RESULTS

F-VALUES/h-statistics.¹

Group ^{2/}	Period		
	1959-1969	1959-1978	1959-1978 (exc. 1971-1973)
1	2.59/1.24	2.42/1.67	2.01/1.15
2	3.19*/-0.15	3.78**/3.00*	3.17*/1.37
3	5.64**/0.13	4.24**/1.05	3.55*/0.97
4	3.61*/-0.16	3.57*/6.50*	2.71*/4.32**
5	2.72/0.61	4.12**/1.41	3.07*/1.54
6	3.96*/0.12	3.04*/1.18	2.35/2.10*
Critical			
F-Values 5%	2.85	2.49	2.57
1%	4.44	3.61	3.79

1. The reported F-values pertain to testing the joint hypothesis that b_i ($b_i = (B_i - B_i)$) for all $i=1, \dots, 5$ are zero in equation (4).

The h-statistics are Durbin's - h to test for serial correlation.

2. The group numbers correspond to the following affiliation: 1) non-financial business, 2) academic institutions, 3) commercial banks, 4) investment banks, 5) the Federal Reserve System, and 6) unspecified.

* Denotes significance at the five percent level.
** Denotes significance at the one percent level.

TABLE 2
CONSISTENCY TEST RESULTS

F-VALUES¹

Group ^{2/}	Period		
	1959-1969	1959-1978	1959-1978 (exc. 1971-1973)
1	0.78	2.42	2.38
2	3.44*	0.99	0.83
3	1.65	1.38	1.29
4	0.55	1.39	1.04
5	1.18	2.81*	3.76**
6	0.64	1.39	1.22
Critical			
F-Values 5%	2.71	2.45	2.49
1%	4.10	3.51	3.61

1. The reported F-values pertain to testing the joint hypothesis that the estimated $\hat{b}_i' = \hat{b}_i''$ and $\hat{b}_i' = \hat{b}_i'' = 0$ for all $i = 1$ from equations (5) and (6).

2. see table 1.

* Denotes significance at the five percent level.

** Denotes represents significance at the one percent level.