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# Forecast Analysis of Food Price Inflation in Pakistan: Applying Rationality Criterion for VAR Forecast

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**Abstract**

Forecast performance is considered to be a tart test of an econometric model. An accurate forecasting system is necessary for every industry to be able to take appropriate actions for future planning and planning creates a substantial need for forecasts. The purpose of this study is to evaluate forecast efficiency by using Rationality criterion of forecasts. It is therefore designed to analyze forecasting efficiency of food price inflation and consumer price index by using thirty three years quarterly data of Pakistan covering the period 1975 to 2008. Forecasts are obtained from VAR model specification. Four forecasting accuracy techniques, such as, Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Theil's Inequality Coefficient (TIC) are used to be able to select the most accurate forecast from VAR. Later on these forecasts are evaluated on the basis of Rationality criterion defined. We found food price forecast are consistent, efficient and fulfilling the criteria of weak and strong rationality given. We propose that assessment of forecasts obtained by applying different criterion used will make them more reliable and correct to be used in policymaking and management decision.

**Keywords:** Food Price Forecasts, Weak Rationality, Strong rationality, Strict rationality

## 1. Introduction

Forecast performance is considered to be a spiky test of an econometric model, particularly when that model is based on a well designed economic theory. Forecast performance is assumed to provide support for theory. This is common concept that a good forecasting performance constitutes a 'seal of approval' to the empirical model and therefore of the theory on which model is based. An accurate forecasting system is necessary for every industry to be able to take appropriate actions for the future. It is widely recognized that one of the most important functions of manager at all levels in an organization is planning, and planning creates a substantial need for forecasts.

Analysis of time series and Yule (1927) forecasting has a longer history. Forecasting is often the goal of a time series analysis. Time series analysis is generally used in business and economics to investigate the dynamic structure of a process, to find the dynamic relationship between variables, to perform seasonal adjustment of economic data and to improve regression analysis when the errors are serially correlated and furthermore to produce point and interval forecast for both level and volatile data series. Accuracy of forecast is important to policymaker

Traditional measure of forecast efficiency was comparison of RMSE. A forecast having lower RMSE considered as the best among the others forecast having a high RMSE. A good criticism on RMSE is made by Armstrong et al. (1995). After the rejection of conventional tools of analyzing the forecast efficiency the co integration approach named consistency was introduced, and this technique was used by Liu et al. (1992) and Aggerwal et al. (1995) to assess the unbiasedness, integration and co integration characteristics of macroeconomic data and their respective forecast. Hafer *et al.* (1985), McNees (1986), Pearce (1987) and Zarnowitz (1984, 1985, 1993) place great weight on minimum mean square error (MSE) but do not incorporate accuracy analysis convincingly in their test of forecast.

Many researchers contribute to rationality testing such as Carlson (1977) Figlewski *et al.* (1981), Friedman

(1980), Gramlich (1983), Mullineaux (1978), Pearce (1979) and Pesando (1975). many studies finds the rationality of IMF and OECD forecasts like Holden *et al*. (1987), Ash *et al*. (1990, 1998), Artis (1996), Pons (1999, 2000, 2001), Kreinin (2000), Oller *et al*. (2000) and Batchelor (2001), these studies shown that the IMF and OECD forecasts pass most of the tests of rationality. Doctrine of rationality is defined by Lee (1991), expectations are said to be rational if they fully incorporate all of the information available to the agents at the time the forecast is made. Efficiency of forecast is being analyzed by different approaches; e.g. Consistent Forecast, Efficient Forecast and Rational Forecast. Bonham *et al.* (1991) include a test for conditional efficiency in the definition of strong rationality. In order to analyze the rationality of price forecast Bonhan *et al.* (1991) define a hierarchy of rationality tests starts from 'weak rationality' to 'strict rationality' as

- Weak rationality
- Sufficient rationality
- Strong rationality
- Strict rationality

## 2. Rationality

### *2.1 Weak Rationality*

Most of the applied work such as Evans *et al.* (1984), Friedman (1980), Pearce (1987) and Zarnowitz (1984, 1985) viewed rationality in term of the necessary conditions of unbiasedness and information efficiency[2]. The same notion of weak rationality was defined by Bonham *et al.* (1991) that the forecast must be unbiased and meet the tests of weak information efficiency. Ruoss (2002) stated that unbiasedness is often tested using the Theil-Mincer-Zarnowitz equation. This is a regression of the actual values on a constant and the forecast values. Clement (1998) suggested to run a regression of the forecast error on the constant, if the constant deviates from zero, the hypothesis that the forecast is unbiased is rejected.

### *2.2 Sufficient Rationality*

The forecast must be weakly rational and must pass a more demanding test of sufficient orthogonality, namely, that the forecast errors not be correlated with any variable in the information set available at the time of prediction

### *2.3 Strong Rationality*

The forecast must be sufficiently rational and pass tests of conditional efficiency. Conditional efficiency requires a comparison of forecasts[3]. Call some sufficiently rational forecast a benchmark. Combine benchmark with some competing forecast. Conditional efficiency refers to Granger *et al.* (1973) concept that measures the reduction in RMSE, which occurs when a forecast is combined with one of its competitors. Against such kind of notion Granger (1989) suggest that combining often produces a forecast superior to both components. Same kind of notion is build by Timmermann (2006) whether forecast can be improved by combining WEO forecasts with the Consensus forecasts. Stock *et al*. (2001) reported broad support for a simple combination of forecasts in a study of a large cross-section of macroeconomic and financial variables. If the combination produces an RMSE that is significantly smaller than the benchmark RMSE, the latter fails the test for conditional efficiency because it has not efficiently utilize some information contained in the competing forecast.

[2] The same kind of unbiasedness and efficiency notion was build by Eichenbaum *et al.* (1988) and Razzak (1997)

[3] Emanating from the classic study by Bates *et al*. (1969) a long literature on forecast combination summarized by Clemen (1989), Diebold *et al*. (1996) and Timmermann (2005) has found evidence that combined forecasts tend to produce better out-of-sample performance than individual forecasting models.

*2.4 Strict Rationality*

Bonham *et al.* (1991) explained in it study that a statement about rationality should not depend on arbitrary selection of time periods. A forecast is strictly rational if it passes tests of strong rationality in a variety of sub periods .Empirical results regarding the rationality of forecasts was explained by Lee (1991) that forecast are fail to be rational in the strong sense even though they are not rejected by the conventional test of weak-form rationality. Ruoss (2002) examine the forecast rationality of the Swiss economy and find GDP forecasts in sample do not pass the most stringent test i.e., the test of strong informational efficiency, because, in some cases, forecasts errors correlate with the forecasts of the other institutes.

Same kind of results are shown by Bonham *et al.* (1991) that the most stringent criteria for testing rationality will not be useful for empirical work. On these criteria there might not be a rational forecast of inflation. Thus there is a tension between what econometricians would like to suggest about rationality and the imperative that agents act on what information they have. This tension might be eliminated by relaxing the criterion that defines strict rationality.

Razzak (1997) and Rich (1989) test the rationality of National Bank of New Zealand's survey data of inflation expectation and SRC expected price change data respectively. Both studies end up with a same conclusion, that the results do not reject the null hypothesis of unbiasedness, efficiency and orthogonality for a sample from their particular survey data series. A study of US and Sweden was ended by Bryan *et al*. (2005) concludes that the US data seems very unsupportive of near-rationality[4], whereas the Swedish is more inconclusive. From all discussion it can be inferred that the central goal is to produce unbiased and efficient forecast with uncorrelated forecast error. Typically as mentioned by Yin-Wong Cheung and Menzie David Chinn (1997)that when examining forecast accuracy researchers examine the mean, variance and serial correlation properties of the forecast error. Following basic principles of economic forecast, the performance of forecast can be evaluated as Unbiased forecast, efficient forecast and have uncorrelated errors.

## 3. Plan of Study

The aim of this study is to assess forecast accuracy by means of Rationality test applied for forecasts of food price inflation and consumer price index data of Pakistan which are essential for efficient planning by farmers and other industries connected to the food production. Such forecasts are also of interest to governments and other organizations. It will consist of 33 years Quarter data covering the period 1975-2008. We will obtain forecasts by VAR model. We will select a number of alternative criteria (such as, Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Theil's Inequality Coefficient (TIC)) for measuring forecast accuracy at the time of selection of best forecasts. In order to test the forecast either they are biased, erratic and unreliable or using existing information in a reasonably effective manner we submit an application of rationality test, these issues of forecast efficiency are rarely addressed. These criteria give different rankings, so there is no guarantee that a forecast that performs well under one criterion is satisfactory under the others. Any conclusion from a given data set should be regarded only as indicators of forecasting ability and not as proof of the correctness of the underlying model and criterion for that data.

In order to test the performance of Food price inflation Forecast , we forecast two data series namely, Food price inflation (CPI food as proxy of food price inflation), consumer price index General (CPIG).The purpose of selecting these two data series is their strong causality with each other.

Quarterly figures are taken from the IMF's International Financial Statistics (2009) and World Bank's World Development Indicator (2009). Data are taken on Quarterly basis for the period 1974-75, 2007-08. It comprises 133 observations from 1974Q2-2008Q2.The corresponding sections will explain the framework of analysis and discussion on result.

### 3.1 Framework of Analysis

[4] The proposition of near-rationality of inflation expectation was suggested by the work of Akerlof *et al*. (2000).

We used VAR approach presented by Sims (1980) for multivariate analysis. In the estimation of VAR we used food price inflation alternatively with the four other variables, Real GDP, M2, Interest rate and Exchange rate.VAR model consists of a set of seemingly unrelated regression (SUR) equations. To tackle autocorrelation, sufficient lag structure has to be considered in the specification of the VAR model. However, to preserve parsimony, lag length need to be justified, therefore we started with a lag of eight periods and then follow 'general to specific' diagnostic/specification procedure. We applied Wald test on the restriction that all the coefficients at eight lag are equal to zero. If this restriction is accepted, the model was re-estimated with seven period lag and same procedure was repeated till the Wald test results supported the rejection of the null hypothesis. Once the VAR model was estimated, we used the selected VAR specification to get forecasts for further application of Rationality test. Performance tests of forecast were based on OLS.

*3.1.1 Weak Rationality Test*

A forecast must be unbiased and meet tests of weak information efficiency to be weakly rational.

In the following equation

$$P^{o}{}_{t} = \alpha_{o} + \alpha_{1} P^{e}{}_{t} + \varepsilon_{t} \qquad 1$$

$P^e$ is the unbiased forecast of $P^o$, if $\varepsilon_t$ is serially uncorrelated, and the coefficients are insignificantly different from zero and one respectively. Weak information efficiency means that the forecast errors $E_t = P^{e}{}_{t} - P^{o}{}_{t}$ are uncorrelated with the past values of the predicted variables. To test the weak efficiency hypothesis we estimate the following regression

$$E_t = \alpha_o + \sum_{i=1}^{m} \alpha_i P^{o}{}_{t-i} + \varepsilon_t \qquad 2$$

If we fail to rejection of the following joint hypothesis it implies that past values help to explain the forecast errors.

$$H_o : \alpha_o = \alpha_j = 0 \quad \textit{for all } j = 1\ldots\ldots\ldots m \qquad 3$$

Acceptance of such hypothesis represent that the forecast error at time t is independent to the past information contained by relevant observed price index.

*3.1.2 Sufficient Rationality Test*

The doctrine of sufficient rationality states that the forecast errors are not correlated with any variable in the information set available at time of forecast. If $Z_t$ is a variable or a vector of variable used to build our forecast model, then $Z_t$ is the exogenous variable in the following equation.

$$E_t = \alpha_o + \sum_{i=1}^{m} \alpha_i Z_{t-i} + \varepsilon_t \qquad 4$$

After estimating the equation 4 we test the following hypothesis

$$H_o : \alpha_o = \alpha_j = 0 \quad \textit{for all } j = 1\ldots\ldots\ldots m \qquad 5$$

The rejection of above mentioned hypothesis states that the information contained in the past values of related series has not been used efficiently in forming the forecast.

*3.1.3 Strong Rationality Test*

A forecast is said to be strongly rational if it passes the test of conditional efficiency suggest by Granger *et al*. (1973). Conditional efficiency requires a comparison of forecasts. Call some sufficiently rational forecast as benchmark; combine the benchmark with some competing forecast. Estimate the following regression.

$$D_t = \alpha + \beta\left[S_t - \overline{S_t}\right] + \varepsilon_t \qquad 6$$

Where $D_t$ and $S_t$ are the difference and the sum of the benchmark and combination forecast errors, respectively, and $\overline{S}_t$ is the mean of the sum. Under the null hypothesis of conditional efficiency, that the combination does not produce a lower RMSE, *($\alpha$=$\beta$=0)*.F test is appropriate if β>0 and the mean errors of both forecasts have the same sign as $\alpha$. If the mean errors of the two forecasts do not have the same sign, then $\alpha$ cannot be interpret as an indicator of the relative bias of the two forecasts.

*3.1.4 Strict rationality Test*

A forecast is strictly rational if it passes tests of strong rationality in a variety of sub periods. If a strongly rational forecast passes the same test based on equation 6 in sub periods then according to Bonham (1991) that particular forecast is awarded as strict rational.

## 4. Results and Discussions

Food Price Inflation (CPIF) and Consumer Price index general (CPIG) both are VAR (1, 2) for our data series .Four variables are included in each model, i.e., Real GDP, M2, Interest Rate and Exchange rate to estimate VAR

Table 1.1 in appendix illustrates forecasts Statistics, Root Mean Squared Error (RMSE), Mean Absolute error (MAE), Mean Absolute percentage errors (MAPE), and Theil Inequality Coefficient TIC. In every case forecast error is defined as the forecast value minus the actual value. The MAE is a measure of overall accuracy that gives an indication of the degree of spread, where all errors are assigned equal weights. The MSE is also a measure of overall accuracy that gives an indication of the degree of spread, but here large errors are given additional weight. It is the most common measure of forecasting accuracy. Often the square root of the MSE, RMSE, is considered, since the seriousness of the forecast error is then denoted in the same dimensions as the actual and forecast values themselves. The MAPE is a relative measure that corresponds to the MAE. The MAPE is the most useful measure to compare the accuracy of forecasts between different items or products since it measures relative performance. If the MAPE calculated value is less than 10 percent, it is interpreted as highly accurate forecasting, between 10 - 20 percent good forecasting, between 20 -50 percent reasonable forecasting and over 50 percent inaccurate forecasting. Theil's Inequality Coefficient (TIC) is another statistical measure of forecast accuracy. A Theil's-U greater than 1.0 indicates that the forecast model is worse; a value less than 1.0 indicates that it is better. The closer U is to 0, the better the model. Wrapping up all this discussion is simply to say that we get best forecast from our data series using VAR model (see statistics in table1.1for detail).

### 4.1 Rationality Test for Forecasts

Carl S. Bonhan and Douglas C. Dacy (1991) classify the rationality of time series forecast as, (1) Weakly rational, (2) sufficiently rational, (3) strongly rational, (4) strictly rational.

*4.1.1 Weak Rationality*

A forecast must be (a) unbiased and meet the tests of (b) weak informational efficiency to be weakly rational.

In this part we estimate the Unbiasness. We regress forecast on observed data series to get forecast errors.

CPIF = 0.5539311996 + 1.001230912*F1
(0.191) (296.822)***

CPIG = 1.591295003 + 1.000070449*F2
(0.681) (400.601)***

Forecasts are significant in explaining the observed series. T-Values in parenthesis indicates it validity.

**Unbiased ness Tests**
**Breusch-Godfrey Serial Correlation LM Test:**

*Table 1.2* *Ho: Serially uncorrelated errors*

| Forecast | F-statistic | Probability | Lag length |
|---|---|---|---|
| CPIF | 0.605 | 0.438 | 1 |
| CPIG | 5.751 | 0.004 | 2 |

Table 1.2 illustrates the results of forecasts errors. CPIG errors are serially correlated whereas CPIF errors are serially uncorrelated which confirms CPIF forecasts are unbiased and passing the Unbaisdness test of forecast though it is not insignificantly different from zero and one.

*Table 1.3*

*Ho: C(1)=0, C(2)=1*

| Forecast | F-statistic | Probability | Chi-square | Probability |
|---|---|---|---|---|
| CPIF | 0.539 | 0.585 | 1.077 | 0.583 |
| CPIG | 0.754 | 0.473 | 1.507 | 0.471 |

Table 1.3 shows that CPIF and CPIG forecast coefficient are insignificantly zero and one as null hypothesis is accepted here.

In order to test the weak information efficiency of forecast we regress our forecasts errors on past predicted values and find they are uncorrelated with forecasts errors.

E1 = -0.3925389311 - 0.001473105748*CPIF (-1)
(-0.136) (-0.431)

E2 = -1.415973065 - 0.0003045008285*CPIG (-1)
(-0.608) (-0.120)

**Weak Informational Efficiency Tests**

*Table1.4*

*Ho: C(1)= C(2)=0*

| Forecast | F-statistic | Probability | Chi-square | Probability |
|---|---|---|---|---|
| CPIF | 0.566 | 0.569 | 1.131 | 0.568 |
| CPIG | 0.761 | 0.470 | 1.521 | 0.467 |

We fail to reject the joint hypothesis reported in table 1.4; it implies that past values help to explain the forecast errors. So CPIF and CPIG both are qualifying the test of weak informational efficiency. It is evident from the table statistics. Acceptance of null hypothesis above represents the forecast error at time t is independent to the past information contained by relevant observed price index.

*4.1.2Sufficient Rationality*

We regress our forecasts error on information set available used to estimate VAR model which is real GDP, M2, interest rate, and exchange rate lags. The doctrine of sufficient rationality states that the forecast errors are not correlated with any variable in the information set available at time of forecast.

E1 = -4.977+ 0.0848*CPIF (-1) + 4.2e-06*RGDP (-1)-9.5e-05*M2 (-1)-1.404*R(-1)-0.816*ER(-1)
(-0.75) (2.59)*** (0.25) (-2.03) ** (-1.71)* (-1.64)*

E2 = 0.025+0.26*CPIG (-1)-1.4e-06*RGDP (-1)-7.9e-06*M2 (-1) -0.02*R (-1)-0.017*ER (-1)
(0.14) (5.091) *** (-2.86) *** (-4.00) *** (-1.17) (-1.98) **

**Sufficient Rationality Tests**

*Table 1.5*

*Ho: All the Coefficients are zero*

| Forecast | F-statistic | Probability | Chi-square | Probability |
|---|---|---|---|---|
| CPIF | 1.470 | 0.194 | 8.823 | 0.184 |
| CPIG | 5.000 | 0.180 | 29.999 | 0.196 |

Table 1.5 statistics are explaining the result of sufficient rationality criterion. The rejection of above mentioned hypothesis states that the information contained in the past values of related series has not been used efficiently in forming the forecast ,as null hypothesis is not rejected here it indicates given information are used in making these forecasts. Therefore both CPIF and CPIG are fulfilling the sufficient rationality criterion.

*4.1.3 Strong Rationality*

A forecast is said to be strongly rational if it passes the test of conditional efficiency suggest by Granger *et al*. (1973). Conditional efficiency requires a comparison of forecasts. In order to Call sufficiently rational forecast we need some forecasts as benchmark, intended for, we get forecasts of CPIF from ARIMA (1, 1, 1) (Auto Regressive Moving Average)[5]; combine this benchmark (ARIMA) with some competing (VAR) forecast. We get forecasts errors and estimate the difference and sum of the benchmark and combination forecast errors and also obtain the mean of the sum to estimate $\alpha$ *and* $\beta$*. Results are reported in table 1.6 in appendix which indicates* The forecast of CPIF obtained from VAR is strongly efficient when combine with an ARIMA forecast of CPIF.

*4.1.4 Strict rationality*

A forecast is strictly rational if it passes tests of strong rationality in a variety of sub periods. In this study forecasts of CPIF met the strong efficient criterion, so we estimated equation 6 in given sub periods and find CPIF did not follow the strict rationality criterion.

We break the sample in following sub periods

- 1975Q3 to 1980Q2
- 1980Q3 to 1985Q4
- 1986Q1 to 1990Q1
- 1990Q2 to 1995Q2
- 1995Q3 to 2000Q4
- 2001Q1 to 2005Q2
- 2005Q3 to 2008Q2

**Conclusion**

| | | **4.1.1** | **4.1.2** | **4.2** | **4.3** | **4.4** |
|---|---|---|---|---|---|---|
| ***Quarter*** | *Food price Inflation* | 1 | 1 | 1 | 1 | NA |
| | *Consumer price index general* | 0 | 1 | NA | NA | NA |

" 1" for meeting the criteria, "0" otherwise and NA/not applicable

4.1.1 Unbiasedness Test
4.1.2 Weak Informational Efficiency Test
4.2 Sufficient Rationality
4.3 Strong Rationality
4.4 Strict Rationality

It is clear from result summary that food price inflation forecast qualify the rationality criterion used to check the accuracy of forecasts, they are unbiased and fulfilling the criterion of weak, sufficient and strong rationality. Consumer price index general forecast are only weakly rational. We infer from our analysis that food price forecast are reliable for further application. Forecasting rationality test reduce the range of uncertainty within which management judgment can be made, so that it can be used in decision making process to the benefits of an organization and policy makers. Food Price Inflation forecasts are satisfying all the criteria used to check the performance of forecast by VAR for given data series. We suggest policy makers and planning authorities for reliance on these criteria to get better forecasts for further appliance. If for every forecast such criterion will be used then more consistent and reliable results can be predicted.

[5] -For more detail see Box, G. E. P. and G. M. Jenkins (1976), "*Time Series Analysis, Forecasting and Control*", Holden-Day, San Francisco.

**References**

Aggarwal, R. Mohanty, S. and Song, F. (1995), "Are Survey Forecasts of Macroeconomic Variables Rational?", *Journal of Business*, 68, (1), 99-119.

Akerlof, G. A., William, T. D. and George, L. P. (2000), "Near-Rational Wage and Price Setting and the Long-Run Phillips Curve", *Brookings Papers on Economics Activity*, 1-60.

Armstrong, J. S. and Fildes R. (1995), "On the Selection of Error Measures for Comparisons among Forecasting Methods", *Journal of Forecasting*, Vol. 14, 67-71.

Artis, M. J. (1996), "*How Accurate are the IMF's Short-term Forecasts? Another Examination of the World Economic Outlook*", International Monetary Fund, Working Paper No. 96/89.

Ash, J. C. K., Smyth, D. J. and Heravi, S. M. (1990), "The Accuracy of OECD Forecasts of the International Economy", *International Journal of Forecasting*, 6, 379-392.

Ash, J. C. K., Smyth, D. J. and Heravi, S. M. (1998), "Are OECD Forecasts Rational and Useful?: A Directional Analysis", *International Journal of Forecasting*, 14, 381-391.

Bakhshi, H., George, K. and Anthony, Y. (2003), "*Rational Expectations and Fixed-Event Forecasts: an Application to UK Inflation*", Bank of England, UK, Working Paper No. 176.

Batchelor, R. (2001), "How Useful are the Forecasts of Intergovernmental Agencies? The OECD and IMF versus the Consensus", *Applied Economics*, 33, 225-235.

Bonham, C. S. and Douglas, C. D. (1991), "In Search of a "Strictly Rational" Forecast", *The Review of Economics and Statistics*, Vol. 73, No. 2, 245-253.

Bonham, C. S. and Cohen, R. (1995), "Testing the Rationality of Price Forecasts: Comment", *The American Economic Review*, Vol. 85, 284-289.

Box, G. E. P. and G. M. Jenkins (1976), "*Time Series Analysis, Forecasting and Control*", Holden-Day, San Francisco.

Bryan, M. F. and Stefan, P. (2005), "*Testing Near-Rationality Using Detailed Survey Data*", Federal Reserve Bank of Cleveland, Working Paper No. 05-02.

Carlson, J. A. (1977), "A Study of Price Forecast", *Annals of Economic and Social Measurement*, 6, 27-56.

Engle, R. F. and C. W. J. Granger, (1987), "Co-integration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 251-276.

Evans, George, and Gulmani, R. (1984), "Tests for Rationality of the Carlson-Parkin Inflation Expectation Data", *Oxford Bulletin of Economics and Statistics*, 46, 1-19.

Figlewski, Stephen and Paul W. (1981), "The Formation of Inflationary Expectations", *Review of Economics and Statistics*, 63, 1-10.

Friedman, Benjamin, M. (1980), "Survey Evidence on the 'Rationality' of Interest Rate Expectations", *Journal of Monetary Economics*, 6, 453-465.

Gramlich, Edward, M. (1983), "Models of Inflation Expectations Formation: A comparison of Households and Economist Forecasts", *Journal of Money, Credit and Banking*, 15, 155-173.

Granger, C. W. J., (1981), "Some Properties of Time Series Data and Their Use in Econometric Model Specification", *Journal of Econometrics*, 16, 121-130.

Granger, C. W. J., (1989), "*Forecasting In Business and Economics*", Second edition Academic Press, London, page 194.

Granger, C. W. J., (1996), "Can We Improve the Perceived Quality of Economic Forecast?", *Journal of Applied Econometrics*, Vol. 11, No. 5, 455-473.

Government of Pakistan, *Economic survey (various issues)*, Islamabad, Ministry of Finance.

Hafer, R. W. and Hein, S. E. (1985), "On the Accuracy of Time Series, Interest Rate, and Survey Forecast of Inflation", *Journal of Business*, 5, 377-398.

Holden, K. and Peel, D. A. (1990), "On Testing for Unbiasedness and Efficiency of Forecasts", *Manchester School*, 58, 120-127.

Lee, Bong-soo (1991), "On the Rationality of Forecasts", *The Review of Economics and Statistics*, Vol. 73, No. 2, 365-370.

Liu, P. and G.S. Maddala (1992), "Rationality of Survey Data and Tests for Market Efficiency in the Foreign Exchange Markets", *Journal of International Money and Finance*, 11, 366-381

McNees, Stephen, K. (1986), "The Accuracy of Two Forecasting Techniques: Some Evidence and Interpretations", *New England Economics Review*, April, 20-31.

 

Mullineaux, D. J. (1978), "On Testing for Rationality: Another Look at the Livingston Price Expectations Data", *Journal of Political Economy*, 86, 329-336.
Pesando, J. E. (1975), "A Note on the Rationality of Livingston Price Expectations", *Journal of Political Economy*, 83, 849-858.
Pons, J. (1999), "Evaluating the OECD's Forecasts for Economic Growth", *Applied Economics*, 31, 893-902.
Pons, J. (2000), "The Accuracy of IMF and OECD Forecasts for G7 Countries", *Journal of Forecasting*, 19, 56-63.
Razzak, W. A. (1997), "Testing the Rationality of the National Bank of New Zealand's Survey Data", *National Bank of New Zealand*, G97/5
Rich, R. W. (1989), "Testing the Rationality of Inflation from Survey Data: Another Look at the SRC Expected Price Change Data", *The Review of Economics and Statistics*, Vol. 71, No. 4, 682-686.
Ruoss, E. and Marcel, S. (2002), "How accurate are GDP Forecast? An Empirical Study for Switzerland", *Quarterly Bulletin, Swiss National Bank, Zurich*, 3, 42-63.
Timmermann, A. (2005), "*Forecast Combinations*" forthcoming in Handbook of Economic Forecasting, Amsterdam, North Holland.
Yule, G. U. (1927), "On a Method of Investigating Periodicities in Disturbed Series with Special Reference to Wolfer's Sunspot Numbers", *Philosophical Transactions of the Royal Society London*, Ser. A, 226, 267-298.
Zarnowitz, V. (1985), "Rational Expectations and Macroeconomic Forecasts", *Journal of Business and Economic Statistics*, 3, 293-311.
Zarnowitz, V. and Phillip, B. (1993), "Twenty-Two Years of the NBER-ASA Quarterly Economic Outlook Surveys: Aspects and Comparisons of Forecasting Performance", *Business Cycles, Indicators and Forecasting*, University of Chicago Press, 11-84

**Appendix**

Table 1.1

**Forecast Statistics of Quarter Data with VAR Model**

| | **CPIF** | **CPIG** |
|---|---|---|
| Included observations | 129 | 127 |
| Root Mean Squared Error | 5.644 | 5.025 |
| Mean Absolute Error | 3.276 | 3.291 |
| Mean Absolute Percentage Error | 1.874 | 1.405 |
| Theil Inequality Coefficient | 0.010 | 0.008 |
| Bias Proportion | 0.74% | 1.19% |
| Variance Proportion | 0.26% | 0.03% |
| Covariance Proportion | 99.00% | 98.78% |

Table 1.6

**Strong Rationality Test Results**

| | Benchmark Forecast | When Combined With |
|---|---|---|
| *Panel A* | CPIF ARIMA | CPIF VAR |
| Sign Mean Error | -ve | -ve |
| α | | 0.386856 |
| β | | -0.042682 |
| Prob. | | Bias |
| Conclusion | | Cannot Reject |
| *Panel B* | CPIF VAR | CPIF ARIMA |
| Sign Mean Error | -ve | -ve |
| α | | -0.387 |
| β | | 0.043 |
| Prob. | | 0.7267 |
| Conclusion | | Cannot Reject |

*Sample 1975Q3 2008Q2*

Result in table 1.6 shows, Panel A the benchmark forecast is ARIMA and in Panel B the benchmark is VAR and combined with an ARIMA forecast of CPIF. The sign of α is same with the sign of mean forecast error in Panel B. It follows the test.