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Rationality Analysis for ARIMA Forecasts

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Abstract

This study is made to evaluate forecast efficiency by applying Rationality criterion for food price inflation, consumer price index general, GDP per capita and Money supply forecasts of Pakistan. It is therefore designed to analyze forecasting efficiency by using thirty three years annual data covering the period 1975 to 2008. We obtained forecasts from ARIMA(Auto Regressive Integrated Moving Average) model specification and select the most accurate forecast on the basis of well known forecasting accuracy techniques that are Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Theil's Inequality Coefficient (TIC). Later on these forecasts are evaluated on the basis of rationality criterion. We found food price forecast are consistent, efficient and fulfilling the criteria given of weak and strong rationality, therefore they are reliable and correct to be used in policymaking and management decision where as other forecasts obtained are not passing all the criteria given except money supply.

Keywords: Food Price Forecasts, Weak Rationality, strong Rationality, ARIMA Forecasts

1.Introduction

Economic theories are usually designed on the basis of econometric testing and forecast performance. Forecast performance is assumed to be providing a support for theory. This is common concept that a good forecasting performance validates the empirical model and therefore of the theory on which model are based.To take appropriate actions in future an accurate forecasting system is inevitable. It is therefore recognized that at all level in an industry one of the most important functions of a manager is planning, and planning demand a substantial need for forecasts.

Forecasting and time series analysis is not a new concept, it dated back to Yule (1927). 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. Efficiency of forecast is being analyzed by different approaches; e.g Consistent Forecast, Efficient Forecast and Rational Forecasts.etc.

The aim of this study is application of different forecast accuracy test named Rationality test in order to get reliable forecasts for food price inflation and other price series in Pakistan which are essential for efficient planning of industries connected to take future decisions. Such forecasts are also of interest to governments and other organizations. Our study will consist of 33 years annual data covering the period 1975-2008. We will forecast by using Box-Jenkins (ARMA). 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 ARIMA forecasts. In order to test the forecast either they are biased, erratic and unreliable or using existing information in a reasonably effective manner we apply rationality test of forecasts which make our study different from other.

These efficiency results obtained provide no surety that a forecast best performance will be remained consistent and same for all data sets. Therefore consequences from given data set should be only considered as a exercise of forecasting evaluation and not as proof of the correctness of the underlying model and criterion for that data.

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.

2. Rationality Criterion

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). There are 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. 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 and Strict 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. 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. 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.

2.4 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.

In the sample of Bonham *et al.* (1991) MEAN5 forecast is the only one that can be considered strongly rational. It might satisfy econometricians and real world agents.

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.

Against the above evidence in favor of rationality, a study of US and Sweden was ended by Bryan *et al*. (2005) conclude that the US data seems very unsupportive of near-rationality, whereas the Swedish is more inconclusive.

3. Plan of Study

We use the Box-Jenkin modeling approach ARIMA, described in a famous book of Univariate analysis by Box et al. (1976).A purpose of this technique is forecasting and is widely used in time series analysis. Performance tests of forecast are based on OLS technique. After three stages of selectiong a model i.e identification, estimation and diagnostic checking, we present the specification of ARIMA models to get forecasts for further application of rationality test.

3.1 Rational Forecast

Bonham *et al.* (1991) define a hierarchy of rationality tests starts from 'weak rationality' to 'strict rationality' the level of hierarchy define as follows:

3.1.1 Weak Rationality

A forecast must be unbiased and meet tests of weak information efficiency. In the following equation.

$$P^o{}_t = \alpha_o + \alpha_1 P^e{}_t + \varepsilon_t \qquad 1$$

Where P^e is the unbiased forecast of P^o, if ε_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

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.

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

Forecasts of ARIMA processes have no information set other than the lags of observed series. For ARIMA forecasts two lags of associated price index are used as information set. 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

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, *(α=β=0)*

F test is appropriate if $\beta>0$ and the mean errors of both forecasts have the same sign as α. If the mean errors of the two forecasts do not have the same sign, then α cannot be interpret as an indicator of the relative bias of the two forecasts.

3.1.4 Strict rationality

A forecast is strictly rational if it passes tests of strong rationality in a variety of sub periods. In this study no one forecasts met the strong efficient criterion, so we could not estimate equation 6 in sub periods. If a strongly rational forecast pass the same test based on equation 6 in sub periods mentioned above then according to Bonham (1991) that particular forecast is awarded as strict rational.

3.2 Data Source

In order to test the performance of forecast , we forecast four data series namely, Food price inflation (CPI food as proxy of food price inflation), consumer price index General (CPIG),Per capita Income per person (GDPI) and Money Supply(M2).The purpose of selecting these data series is their causality with each other.All the data are taken from various issues of Economic Survey of Pakistan, Annual Reports of State Bank of Pakistan. Data are taken on annual basis for the period 1974-75, 2007-08.

4. Results and Discussions

Data collected over time tend to exhibit trends, seasonal patterns and so forth observations in different time periods are related to one another or auto correlated. Autocorrelation exists when successive observations over time are related. ARIMA (autoregressive integrated moving average) models are a class of linear models that are capable of representing stationary as well as non stationary time series. ARIMA models make use of the information in the series itself to generate forecasts. These models rely on the autocorrelation pattern in the data.

For our data series CPIF is ARIMA(1,1,1), CPIG is ARIMA(0,1,1) ,GDPI is ARIMA(0,1,1,) and M2 is ARIMA(0,1,1) .We have to take the first difference and log to make our series stationary. We uses an iterative model building strategy that consists of selecting an initial model (model identification), estimating the model coefficients (parameter estimation) and analyzing the residuals (model checking), if necessary, the initial model is modified and the process is repeated until the residuals indicate no further modification is necessary.

Table 1.1

Univariate Models

	Δ(log(CPIF))	Δ(log(CPIG))	Δ(log(GDPI))	Δ(log(M2))
Constant	0.056	0.09	0.093	0.096
	(3.215)***	(7.28)***	(7.332)***	(7.601)***
AR(1)	0.557	-----	-----	-----
	(2.310)***	-----	-----	-----
MA(1)	-0.524	0.646	0.444	0.350
	(-1.776)*	(4.783)***	(2.382)**	(1.929)*
R-squared	0.144	0.362	0.132	0.091
Adjusted R-squared	0.083	0.340	0.103	0.061
Durbin-Watson stat	1.955	1.792	1.939	1.970

t-Statistics are in the parenthesis

*** Significant at 1% level of Significant

** Significant at 5 % level of Significant

* Significant at 10% level of Significant

Table 1.2

Specification of ARIMA Models

Data series	Food Price Inflation Index	ARIMA (1,1,1)
	Consumer Price General Index	ARIMA (0,1,1)
	GDP Per Capita	ARIMA (0,1,1)
	Money Supply	ARIMA (0,1,1)

Table 1.3

Forecast Statistics of Data for Univariate Time Series Models

	CPIF	CPIG	GDPI	M2
Included observations	33	33	32	30
Root Mean Squared Error	2.819	2.409	3.969	3.889
Mean Absolute Error	1.744	1.448	1.949	1.933
Mean Absolute Percentage Error	3.933	3.013	3.507	3.752
Theil Inequality Coefficient	0.022	0.020	0.034	0.033
Bias Proportion	0.74%	3.75%	0.24%	0.07%
Variance Proportion	0.29%	12.52%	0.35%	0.08%
Covariance Proportion	98.97%	83.72%	99.42%	99.84%

Table 1.3 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, lesser will be the error better will be the forecasts. We get best forecast from our data series applying ARIMA as it is evident from statistics above.

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.

4.1.1Weak Rationality

A forecast must be (1) unbiased and meet the tests of (2) weak informational efficiency to be weakly rational.

(1)Unbiasness

In this part we estimate the equation (1) given in section (2) to find unbiasness.We regress forecast on observed data series to get forecast errors.

CPIF = 0.1936857974 + 1.000888653*F(61.022)***

(0.018) (51.032)***

CPIG = 0.8056589655 + 0.974742599*F2(89.245)***

(1.1129) (79.434)***

GDPI = 0.4255684296 + 0.9867285347*F3 (47.547)***

(0.432) (57.545)***

M2 = 0.02892527626 + 0.9971623898*F4 (49.695)***
(0.341) (48.695)***

Unbiased ness Tests
Breusch-Godfrey Serial Correlation LM Test: lag (1)
Table-1.4 ***Ho: Serially uncorrelated errors***

Forecast	F-statistic	Probability
CPIF	1.305	0.263
CPIG	**9.286**	**0.005**
GDPI	**4.492**	**0.043**
M2	2.564	0.120

Table 1.4 illustrates the CPIG and GDPI errors are serially correlated whereas CPIF and M2 errors are serially uncorrelated which confirm forecasts are unbiased and passing the Unbaisdness test of forecasts.

Table-1.5 ***Ho: C(1)=0, C(2)=1***

Forecast	F-statistic	Probability	Chi-square	Probability
CPIF	0.109	0.897	0.219	0.896
CPIG	**3.363**	**0.048**	**6.727**	**0.035**
GDPI	0.240	0.788	0.481	0.786
M2	0.021	0.979	0.041	0.979

Table 1.5 shows that CPIF, GDPI and M2 forecast coefficient are insignificantly zero and one as null hypothesis is accepted here whereas it is significantly different from zero and one only for CPIG forecasts.

4.1.2 Weak Informational Efficiency

In order to test the weak information efficiency we regress our forecasts errors on past predicted values of data indices.

E1 = -0.1983898763 - 0.0008523681512*CPIF(-1)

(-0.193) (-0.049)

E2 = -0.7328195945 + 0.02594068168*CPIG(-1)

(-1.077) (2.181)**

E3 = -0.3272767729 + 0.01228269657*GDPI(-1)

(-0.268) (0.529)

E4 = 0.03268773627 + 0.001678322731*M2(-1)

(0.0275) (0.0749)

Weak Informational Efficiency Tests

Table-1.6 ***Ho: C(1)= C(2)=0***

Forecast	F-statistic	Probability	Chi-square	Probability
CPIF	0.109	0.897	0.218	0.897
CPIG	**3.056**	**0.062**	**6.112**	**0.047**
GDPI	0.176	0.840	0.351	0.839
M2	0.014	0.987	0.027	0.987

Table 1.6 demonstrates the statistics for the selection of Weak Informational Efficiency test based on the acceptance of null hypothesis which indicates forecast error at time t is independent to the past information contained by relevant observed data series. CPIF, GDPI and M2 appear to be passing these criteria.

4.1.3 Sufficient Rationality

We regress our forecasts error on information set which is lags of observed series in our study because we are using ARIMA forecasts for our analysis.

E1 = -0.02869688136 - 0.2051616001*CPIF(-1) + 0.2144401712*CPIF(-2)

(-0.028) (-1.106) (1.106)

E4 = 0.5211924548 + 0.3447658735*M2(-1) - 0.3889922157*M2(-2)

(0.426) (1.854)* (-1.863)*

We apply this test only for the data series (CPIF and M2) which pass the unbaisaness test criterion.

Sufficient Rationality Tests

Table-1.7 ***Ho: C(1)= C(2)=C(3)=0***

Forecast	F-statistic	Probability	Chi-square	Probability
CPIF	0.481	0.698	1.444	0.695
M2	1.168	0.340	3.503	0.320

Table 1.7 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. CPIF and M2 qualify the test.

5. Conclusion

Among Our data series forecasts, food price inflation and money supply pass the Rationality criterion used to check the accuracy of forecasts, they are unbiased and fulfilling the criterion of weak and sufficient rationality where as strong and strict rationality are not applicable here. 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 obtained by ARIMA classification for given data set. 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.

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.
State Bank of Pakistan, *Annual Reports (various issues)*, Karachi.
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