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Forecasting the Shock in Economic Data Series using Error Forecast

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Abstract

In this paper, we discussed the Statistical modeling of the original data series and the residuals series. Residual series has been use for the forecasting the shock occurring in the economic data series. Objective and Subjective technique has been used for the modeling.

Keywords: Forecasting, Error forecasting, Box Jenkins method, Objective and subjective approaches.

1. Introduction

Currently, the subjective and objective approach has been widely used for the forecasting purposes. Subjective approach is the Box Jenkins methodology and Objective approach is the new methodology. There are different modeling has been done in the literature regarding to the Foreign Direct Investment.

Sipos et al. (2008) used the autoregressive econometric models to evaluate the impact of the foreign investments in any form whatsoever, on the Romanian economy. Liu X et al. (2002) discussed the impact of foreign direct investment on labor productivity in the Chinese electronics industry. The importance of the Foreign Direct Investment (FDI) in the economic development has been discussed many authors including Fleisher and Chen (1997), Walz (1997), Markusen and Venables (1999) and De Mello (199).

In the objective approach, time series models has been used for the forecasting using the residuals series as an independent variable (explanatory or auxiliary variable

Two main stages for this purpose are as follows:

Stage 1 Build the appropriate models on the original series using Box Jenkins methodology. After selecting the appropriate models and determined the residuals series of that model. (Subjective Approach)

Stage 2 Statistical modeling has been conducting on the error series, for model building there are different methods to adopt the models.

2. Methodology

A different time series model has been used for the data series of FDI. There are different models has been used which are AR(p) MA(q) and ARIMA(p,d,q) using the subjective approach. All the important steps have been followed for the modeling of the FDI and determine the residuals for each model. After determine the residuals, first technique has been used on the residuals series which are given below:

- Apply the same model of the original series on the residuals series
- Apply the appropriate models for the residuals series
- Predict the error using the time period as independent variable.(Regression Model)
- Predict the residual using the regression model with random numbers as an independent variable.

At the end build the model on the original series using the residuals series as an explanatory variable like as the REG-ARIMA modeling.

3. Data Analysis

In the data analysis, followed the following steps: (Subjective Approach)

- Check the Stationary of the data using ADF
- Determine the order of the ARIMA(p,d,q) model
- Estimate the parameter of the models.
- Residuals testing (AC, PAC, ARCH)
- Forecasting.

After following the above necessary steps for the subjective approach, we noted that first step shows that series is not stationary and it is stationary at 1st difference. There are four models have been used for data series which are given below:

- a) AR(1)
- b) MA(1)
- c) AR(1), AR(2)
- d) ARMA(1,2) (using 1^{st} diff. series)

After applying these models, determine the residuals of each model and apply the same model on the residuals and forecast the residuals.

4. Objective Approach

At that stage objective approach has been used and applying the above four models using their residuals series as an independent variable. In the literature VECM (Vector Error Correction Mechanism) and Co-integration techniques are available when the explanatory variables for the forecasting. There are some limitations in these techniques likes "order of co-integration should be same", "Long Term relations", "lags of error" etc.

5. Results

Results of Objective and Subjective Approach are as follows:



6. Discussion

From the above result, objective technique performs better in the situation of shock occurring in the data series. Graphical representation clearly shows the shock occurring in the data. The second important results are that the co-efficient of the residuals series is the significant in each model. On the other hand, objective approach shows that shock will occur in the future from the graph given below. This approach also shows the long term behavior of the data series.



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	Notations				
Y, LY	Foreign Direct Investment (Monthly series)				
AR1	Forecast using AR1 Model				
AR12	Forecast using AR1& AR2 Model				
ARMA12	Forecast using ARMA(1,2) Model				
MA1	Forecast using MA1 Model				
LYF_AR1_E	Forecast using AR1 Model on (Using AR1 error as independent)				
LYF_AR12_E	Forecast using AR1&AR2 Model on (Using AR1 &AR2 models error as independent)				
LYF_ARMA12_E	Forecast using ARMA(1,2) Model on (Using ARMA(1,2) error as independent)				
LYF_MA1_e	Forecast using MA1 Model on (Using MA1 error as independent)				

Appendix

Correlogram (Actual Data Series)

Sample: 2001M07 2009M12 Included observations: 90

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1	I	1	0.759	0.759	53.619	0.000
	· · ·	2	0.691	0.271	98.547	0.000
		3	0.706	0.302	146.05	0.000
	I I	4	0.659	0.070	187.86	0.000
1	I I I	5	0.626	0.062	226.05	0.000
1		6	0.660	0.187	268.97	0.000
		7	0.567	-0.152	301.04	0.000
1		8	0.538	0.006	330.21	0.000
1		9	0.563	0.079	362.62	0.000
	'Ľ	10	0.509	-0.050	389.47	0.000
	· · ·	11	0.488	0.033	414.48	0.000
		12	0.533	0.123	444.62	0.000
		13	0.429	-0.184	464.38	0.000
		14	0.419	0.044	483.50	0.000
		15	0.456	0.060	506.50	0.000
		16	0.374	-0.133	522.16	0.000
		11	0.337	-0.032	535.02	0.000
		18	0.362	0.003	550.12	0.000
		19	0.280	-0.095	559.23	0.000
	'亅'	20	0.221	-0.123	565.03	0.000
	L != !	21	0.220	-0.077	570.86	0.000
		22	0.141	-0.097	573.29	0.000
: E:	│	23	0.138	0.072	575.64	0.000
: F':		24	0.115	-0.136	577.30	0.000
: P :		20	0.033	-0.057	577.43	0.000
	1 11	20	0.006	-0.023	577.44	0.000
: .	1 : 5	21	0.010	-0.057	577.60	0.000
	1 2 6 2	28	-0.036	0.062	577.74	0.000
		29	-0.026	0.075	577.00	0.000
	1 : "6. :	30	-0.028	-0.020	570 55	0.000
: 4 :		31	-0.072	0.076	570.50	0.000
: : :		32	-0.065	0.014	579.59	0.000
		23	-0.039	0.113	520.40	0.000
		25	-0.006	0.099	500.40	0.000
: : :		20	-0.057	0.049	500.95	0.000
' 4 '		30	-0.048	0.100	061.30	0.000

Basit and Aslam

Table 1:ADF

Null Hypothesis: D(LY) has a unit root					
Exogenous: None					
Lag Length: 4 (Automatic based on AIC, MAXLAG=11)					
t-Statistic Prob.*					
Augmented Dickey-Fuller test statistic -6.816277 0.0				0.0000	
Test critical values: 1% level -2.592782					
5% level -1.944713					
10% level -1.614233					
*MacKinnon (1996) o	*MacKinnon (1996) one-sided p-values.				

Table 2:AR(1) Model

Dependent Variable: D(L					
Method: Least Squares					
Sample (adjusted): 2001N	109 2008M12				
Included observations: 88	after adjustments	S			
Convergence achieved after 3 iterations					
Variable	Coefficient	Std. Error	t-Statistic	Prob.	
AR(1)	-0.373698	0.100471	-3.719475	0.0004	
R-squared	0.134819	Mean deper	ndent var	0.037346	
Adjusted R-squared	0.134819	0.134819 S.D. dependent var 0.714			
S.E. of regression	0.665034 Akaike info criterion 2.0				
Sum squared resid	38.47754 Schwarz criterion 2.0614				
Log likelihood	-88.46706	Durbin-Wa	tson stat	2.261419	
Inverted AR Roots	37				

Dependent Variable: D(LY) Method: Least Squares Sample (adjusted): 2001M10 2008M12 Included observations: 87 after adjustments Convergence achieved after 3 iterations						
Variable	Coefficient	t Std. Error t-Statistic Prol				
AR(1)	-0.525821	0.100748 -5.219171		0.0000		
AR(2)	-0.401929	0.100852 -3.985338 0.00				
R-squared	0.270455	Mean dependent var 0.042016				
Adjusted R-squared	0.261872	S.D. depe	endent var	0.717768		
S.E. of regression	0.616666	Akaike ir	nfo criterion	1.893741		
Sum squared resid	32.32352	Schwarz criterion 1.950429				
Log likelihood	-80.37774	Durbin-Watson stat 2.018438				
Inverted AR Roots	26+.58i	2658i				

Table 3:AR(1), AR(2) Model

Table 4: ARIMA(1,1,2) Model

Dependent Variable: D(LY) Method: Least Squares Sample (adjusted): 2001M09 2008M12 Included observations: 88 after adjustments Convergence achieved after 7 iterations Backcast: 2001M07 2001M08						
Variable	Coefficient	Std. Error	t-Statistic	Prob.		
AR(1)	-0.647365	0.093767	-6.903965	0.0000		
MA(2)	-0.600497	0.097532	-6.156955	0.0000		
R-squared	0.321910	Mean de	bendent var	0.037346		
Adjusted R-squared	0.314025	S.D. depe	endent var	0.714974		
S.E. of regression	0.592168	Akaike ir	nfo criterion	1.812411		
Sum squared resid	30.15699	Schwarz criterion 1.868714				
Log likelihood	-77.74610	Durbin-W	Vatson stat	1.951078		
Inverted AR Roots	65					
Inverted MA Roots	.77	77				

Table	5:MA(1	l) Model
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Dependent Variable: D(LY) Method: Least Squares Sample (adjusted): 2001M08 2008M12 Included observations: 89 after adjustments Convergence achieved after 7 iterations Backcast: 2001M07					
Variable	Coefficient	Std. Error	t-Statistic	Prob.	
MA(1)	-0.740036	0.071144	0.0000		
R-squared	0.294623	Mean dep	pendent var	0.037864	
Adjusted R-squared	0.294623	S.D. depe	endent var	0.710917	
S.E. of regression	0.597076	Akaike ir	nfo criterion	1.817628	
Sum squared resid	31.37198	98Schwarz criterion1.845590			
Log likelihood	-79.88443	-79.88443 Durbin-Watson stat 1.824853			
Inverted MA Roots			.74		

Table 6:AR(1) Model (Using Objective Technique)

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Dependent Variable: D(LY) Method: Least Squares Sample (adjusted): 2001M10 2008M12 Included observations: 87 after adjustments Convergence achieved after 19 iterations						
Variable	Coefficient	Coefficient Std. Error t-Statistic Prob.				
AR1_E	0.901233	0.040854	22.05971	0.0000		
AR(1)	-0.494609	0.103896	-4.760630	0.0000		
R-squared	0.889382	Mean dep	endent var	0.042016		
Adjusted R-squared	0.888081	S.D. depe	endent var	0.717768		
S.E. of regression	0.240125	Akaike inf	o criterion	0.007402		
Sum squared resid	4.901081 Schwarz criterion 0.064089					
Log likelihood	1.678023 Durbin-Watson stat 2.460630					
Inverted AR Roots		4	9			

Table 7:	AR(1),	AR(2)	Model
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Dependent Variable: D(LY) Method: Least Squares Date: 27/07/09 Time: 17:32 Sample (adjusted): 2001M12 2008M12 Included observations: 85 after adjustments Convergence achieved after 56 iterations						
Variable	Coefficient	Std. Error	t-Statistic	Prob.		
AR12_E	1.115816	0.056406	19.78174	0.0000		
AR(1)	0.226065	0.100058	2.259345	0.0265		
AR(2)	-0.472399	0.097635	-4.838444	0.0000		
R-squared	0.782823	Mean dep	endent var	0.033230		
Adjusted R-squared	0.777526	S.D. depe	endent var	0.717996		
S.E. of regression	0.338658	Akaike info criterion 0.707006				
Sum squared resid	9.404535	Schwarz criterion 0.793217				
Log likelihood	-27.04776	Durbin-Watson stat 1.841936				
Inverted AR Roots .1168i .11+.68i						

Table 8: ARIMA(1,1,2) Model

Dependent Variable: D(LY) Method: Least Squares Sample (adjusted): 2001M10 2008M12 Included observations: 87 after adjustments Convergence achieved after 16 iterations Backcast: 2001M08 2001M09						
Variable	Coefficient	Std. Error	t-Statistic	Prob.		
ARMA12_E	1.272966	0.043921	28.98287	0.0000		
AR(1)	0.751300	0.085034	8.835257	0.0000		
MA(2)	-0.602980	0.095637	-6.304904	0.0000		
R-squared	0.739661	Mean dep	endent var	0.042016		
Adjusted R-squared	0.733463	S.D. depe	endent var	0.717768		
S.E. of regression	0.370564	Akaike int	fo criterion	0.886292		
Sum squared resid	11.53468	1.53468 Schwarz criterion 0.971324				
Log likelihood	-35.55372 Durbin-Watson stat 2.146812					
Inverted AR Roots	.75					
Inverted MA Roots	.78	.7878				

Table 9:MA(1) Model

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Dependent Variable: D(LY) Method: Least Squares Sample (adjusted): 2001M08 2008M12 Included observations: 89 after adjustments Convergence achieved after 221 iterations Backcast: 2001M07						
Variable	Coefficient	Std. Error	t-Statistic	Prob.		
MA1_E	1.378694	0.067707	20.36252	0.0000		
MA(1)	0.649952	0.081008	8.023354	0.0000		
R-squared	0.628406	Mean dependent var		0.037864		
Adjusted R-squared	0.624134	S.D. dependent var		0.710917		
S.E. of regression	0.435848	Akaike info criterion		1.199171		
Sum squared resid	16.52685	Schwarz criterion		1.255095		
Log likelihood	-51.36310	Durbin-Watson stat		2.065797		
Inverted MA Roots	65					

Table 10: Correlation Matrix

Correlation Between LY and Error Terms					
	Pearson Correlation	Sig. (2-tailed)	Ν		
AR1_e	0.390	0.000	88		
AR12_e	0.398	0.000	87		
MA1_e	0.452	0.000	89		
ARMA12-e	0.457	0.000	88		

Data Series (July, 2001 to December, 2008)