Impact of COVID-19 on US Airlines: Delta VS Jet Blue

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EMPIRICAL PROJECT
Event Study

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Contents

Overview

- Legacy vs Low Cost Carriers (LCC)
- Impact of major historical events on US Aviation Industry
- COVID-19

Context

- **What is the market?**
  All Domestic flights in the United States.

- **Who/what is concerned?**
  1 legacy carrier and 1 low-cost carrier: Delta Airlines and Jet Blue Airlines.
  Effect of COVID-19 on Operating Revenues

- **Data - from where?**
  Bureau of Transportation Statistics, United States Department of Transportation.

- **Period of Consideration**
  Data taken between Q1 of 2017 till Q3 of 2023.

COVID-19 Timeline

Pre-COVID

Q1 of 2020 (To take into account the effects of anticipating the event)

COVID

Q2 of 2020 to Q1 of 2021

Post-COVID

Q2 of 2021 to Q3 of 2023. (To take into account the effects observed after the event has occurred.)

Other factors affecting Operating Revenue:

- No.of flights
- Load factor (= RPK/ASK)

Rebuttable Hypothesis:

1. COVID-19 has a negative impact on the Operating Revenues of US Airlines (particularly Delta and Jet Blue).
2. COVID-19 has a higher negative impact on Legacy Airlines (Delta) than on Low-Cost Carriers (Jet Blue)

Data and Variables

Type of Data:

Panel Data

No. of observations:

t=27 Quarters and i=2 (Delta and Jet Blue)

DEPENDENT VARIABLE:

- *lny* (y - Inflation adjusted operating revenue in 1000s of 2023$)

EXPLANATORY VARIABLES:

- *lnf* (f - No. of flights taken in a quarter; control)
- *n* (Load Factor in %; control)
- *cov* (COVID-19 - Binary variable; 0 - No COVID 1 - Presence of Covid)
- *befcov* (Before COVID-19 - Binary variable)
- *afcov* (After COVID-19 - Binary variable)

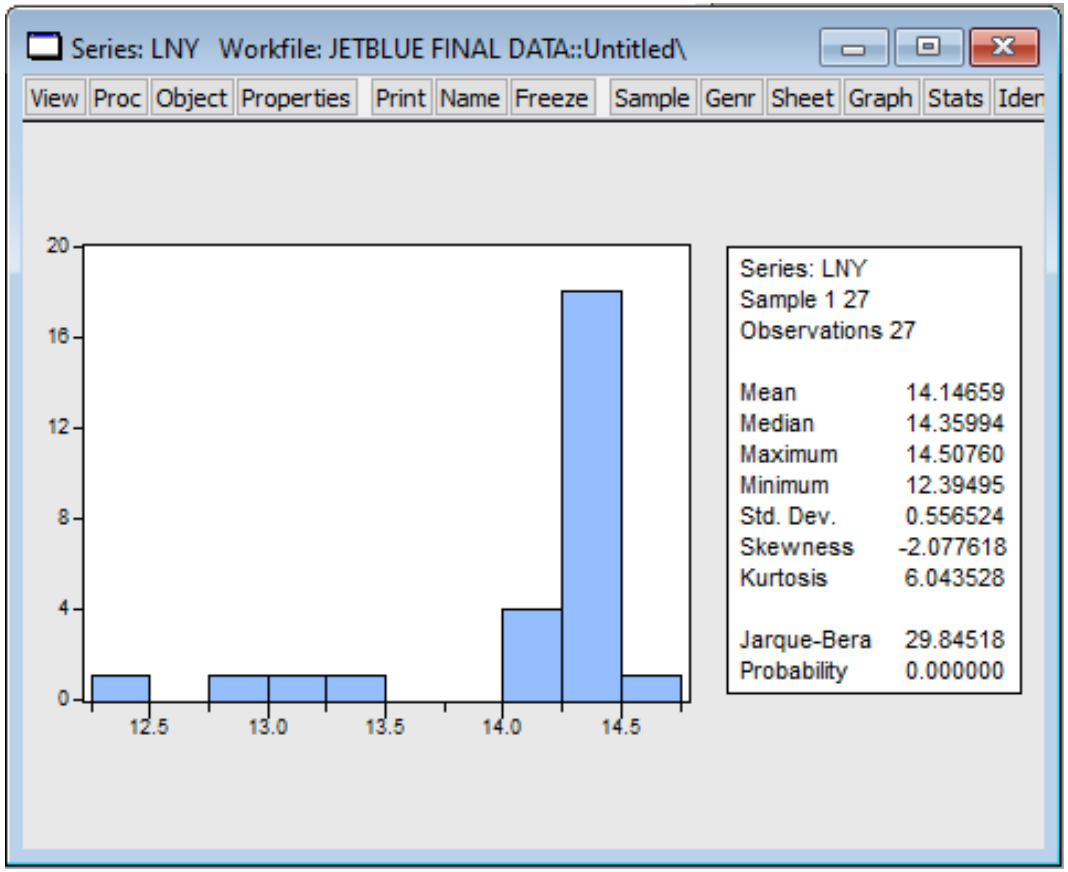
Model

For both Delta and Jet Blue,

LINEAR REGRESSION EQUATION:

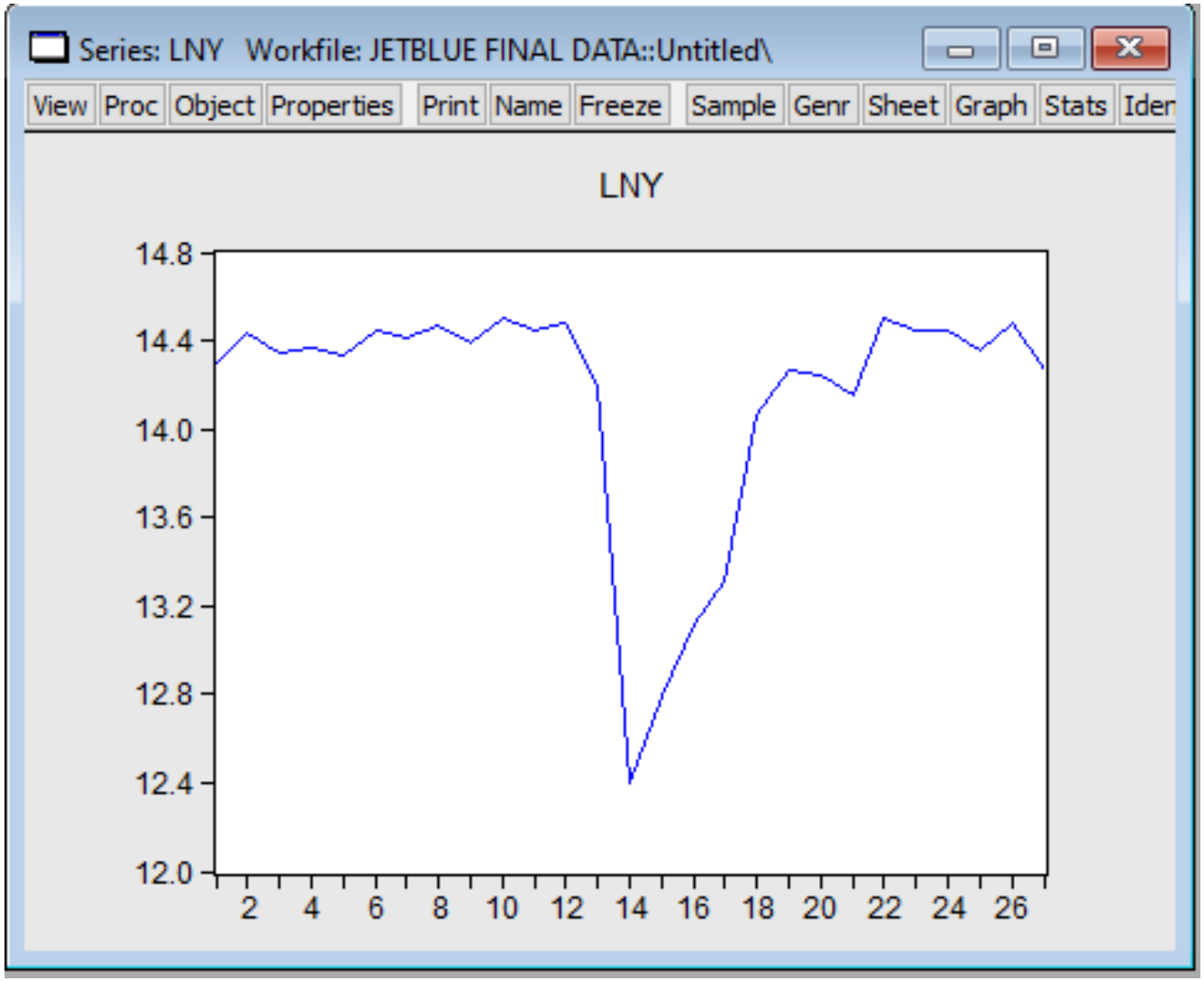
$$(lny)_{i,t} = \beta_1 + \beta_2(lnf)_{i,t} + \beta_3(n)_{i,t} + \beta_4(befcov)_{i,t} + \beta_5(cov)_{i,t} + \beta_6(afcov)_{i,t} + u_{i,t}$$

Dependent Variable Distribution (Jet Blue)



- Normal Distribution is rejected
- **Data not Normally Distributed: Left Skew**
- Lot of Outliers

Dependent Variable Distribution (Jet Blue)



Regression Outcomes (Jet Blue)

lny = 6.407 + 0.629*lnf + 1.118*n + 0.019*befcov - 0.376*cov + 0.033*afcov

EViews - [Equation: EQ01 Workfile: JETBLUE FINAL DATA::Untitled\]

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Dependent Variable: LNY
Method: Least Squares
Date: 01/16/24 Time: 16:49
Sample: 1 27
Included observations: 27

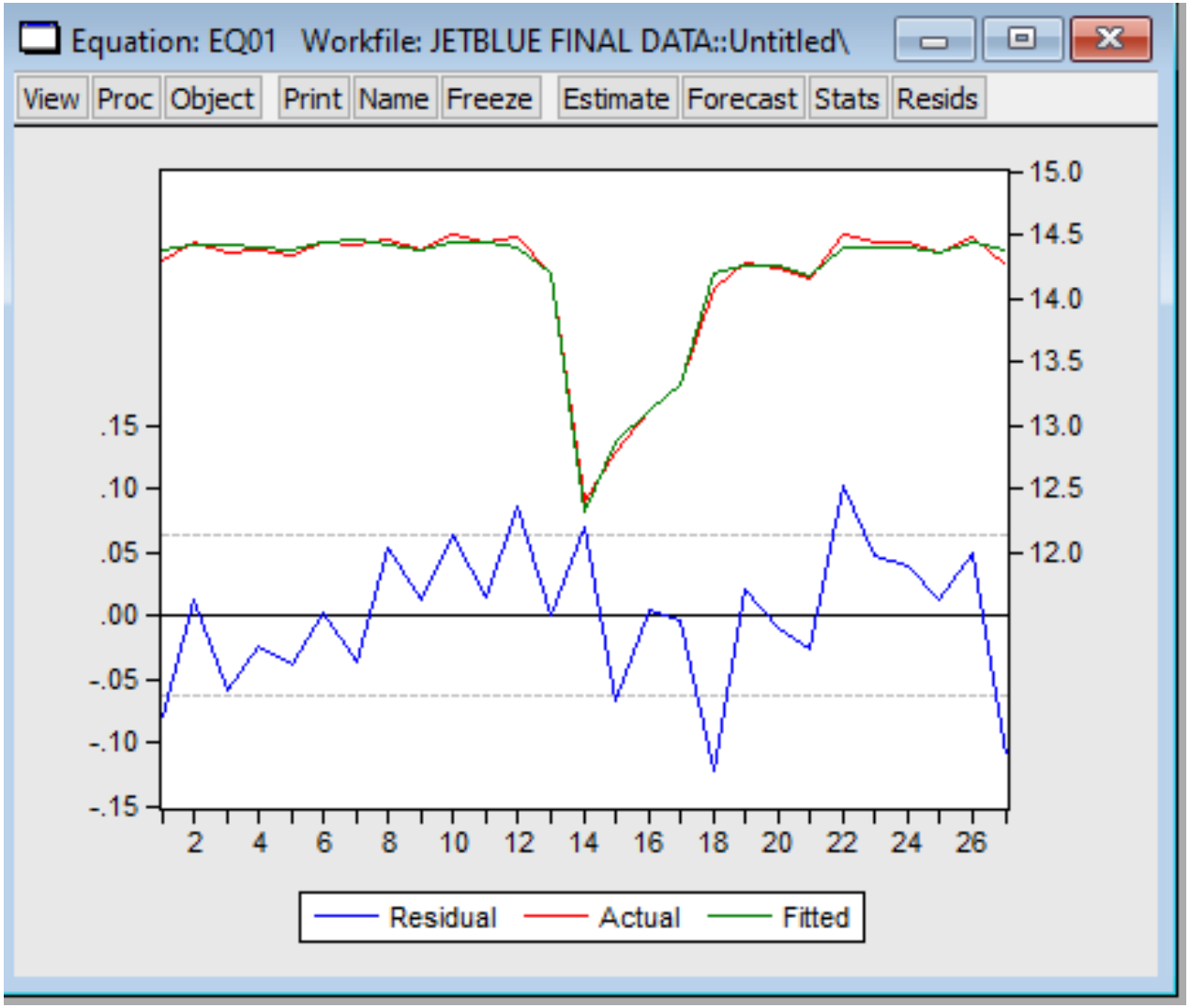
	Coefficient	Std. Error	t-Statistic	Prob.
C	6.407494	1.094266	5.855519	0.0000
LNF	0.629494	0.113943	5.524654	0.0000
N	1.118399	0.313339	3.569294	0.0018
BEFCOV	0.019414	0.081366	0.238598	0.8137
COV	-0.376117	0.096294	-3.905924	0.0008
AFCOV	0.033657	0.029486	1.141463	0.2665

R-squared	0.989815	Mean dependent var	14.14659
Adjusted R-squared	0.987390	S.D. dependent var	0.556524
S.E. of regression	0.062494	Akaike info criterion	-2.514349
Sum squared resid	0.082017	Schwarz criterion	-2.226385
Log likelihood	39.94370	Hannan-Quinn criter.	-2.428722
F-statistic	408.1709	Durbin-Watson stat	1.898117
Prob(F-statistic)	0.000000		

- Validity of individual explanatory variables: T- Statistic
- Validity of all explanatory variables: F- Statistic
- R^2 : 0.99
- Adj R^2: 0.99

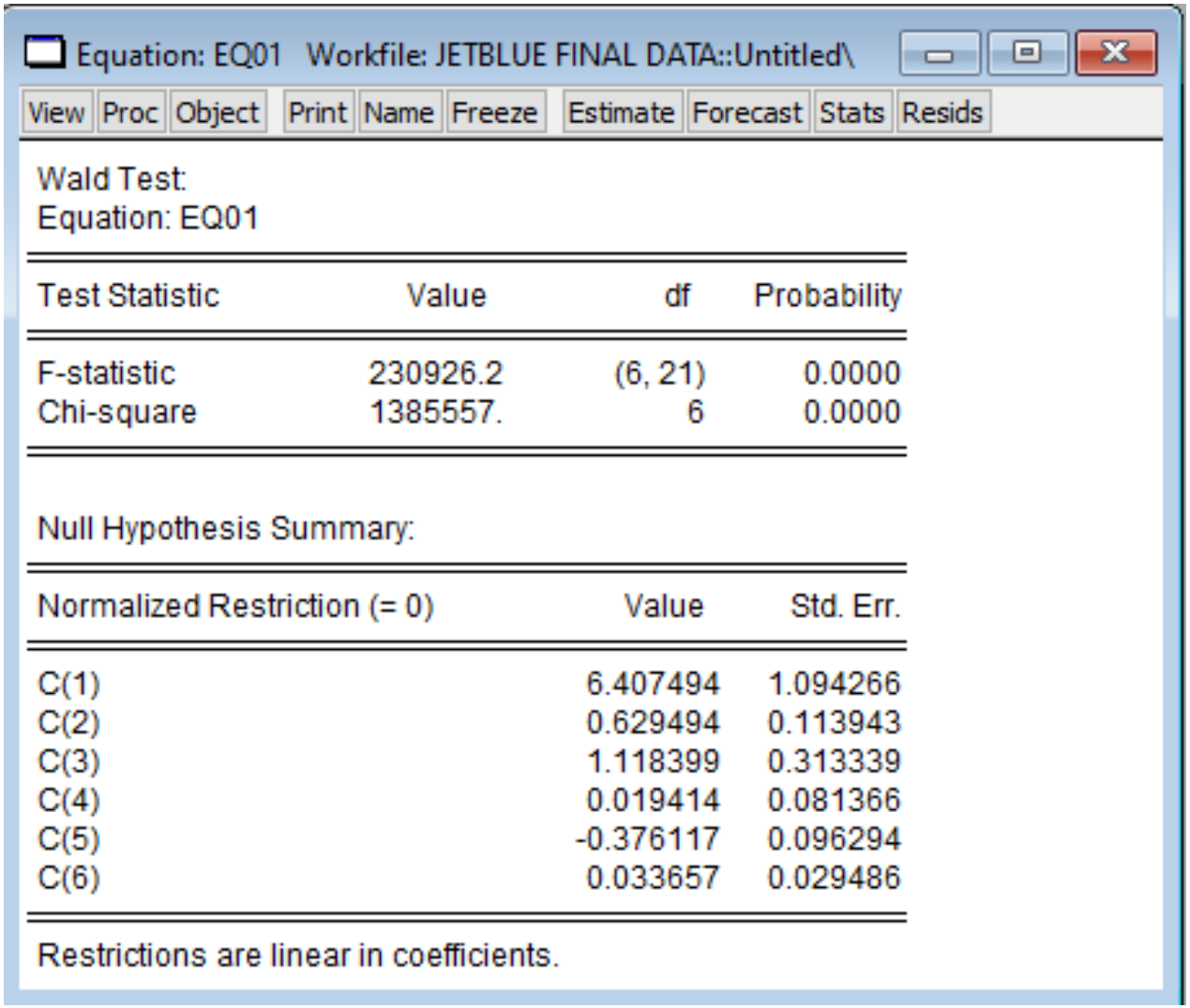
Note: Reject the validity of the "befcov" variable.

Regression Outcomes (Jet Blue)



Wald Coefficient Restriction Test (Jet Blue)

The values of the probability are 0 = All variables matter



Equation: EQ01 Workfile: JETBLUE FINAL DATA::Untitled\

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Wald Test:
Equation: EQ01

Test Statistic	Value	df	Probability
F-statistic	230926.2	(6, 21)	0.0000
Chi-square	1385557.	6	0.0000

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	6.407494	1.094266
C(2)	0.629494	0.113943
C(3)	1.118399	0.313339
C(4)	0.019414	0.081366
C(5)	-0.376117	0.096294
C(6)	0.033657	0.029486

Restrictions are linear in coefficients.

Ramsay Reset Test (Jet Blue)

EViews - [Equation: EQ01 Workfile: JETBLUE FINAL DATA::Untitled\]

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iew Proc Object Print Name Freeze Estimate Forecast Stats Resids

Ramsey RESET Test:

F-statistic	8.185523	Prob. F(1,20)	0.0097
Log likelihood ratio	9.263058	Prob. Chi-Square(1)	0.0023

Test Equation:
Dependent Variable: LNY
Method: Least Squares
Date: 01/16/24 Time: 17:56
Sample: 1 27
Included observations: 27

	Coefficient	Std. Error	t-Statistic	Prob.
C	5.953341	0.957784	6.215747	0.0000
LNF	-2.317097	1.034589	-2.239630	0.0366
N	-4.423235	1.955725	-2.261685	0.0350
BEFCOV	-0.002464	0.070647	-0.034884	0.9725
COV	1.761958	0.751916	2.343290	0.0296
AFCOV	-0.079120	0.046921	-1.686245	0.1073
FITTED^2	0.183829	0.064253	2.861035	0.0097

R-squared	0.992773	Mean dependent var	14.14659
Adjusted R-squared	0.990605	S.D. dependent var	0.556524
S.E. of regression	0.053943	Akaike info criterion	-2.783351
Sum squared resid	0.058198	Schwarz criterion	-2.447393
Log likelihood	44.57523	Hannan-Quinn criter.	-2.683453
F-statistic	457.8924	Durbin-Watson stat	1.561501
Prob(F-statistic)	0.000000		

CHECKING THE LINEARITY OF THE MODEL (CA1):

Non-linearity is rejected at 99% level

White Test(Jet Blue)

Heteroskedasticity Test: White

F-statistic	3.867309	Prob. F(12,14)	0.0093
Obs*R-squared	20.74252	Prob. Chi-Square(12)	0.0543
Scaled explained SS	10.65334	Prob. Chi-Square(12)	0.5588

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/16/24 Time: 18:00
Sample: 1 27
Included observations: 27
Collinear test regressors dropped from specification

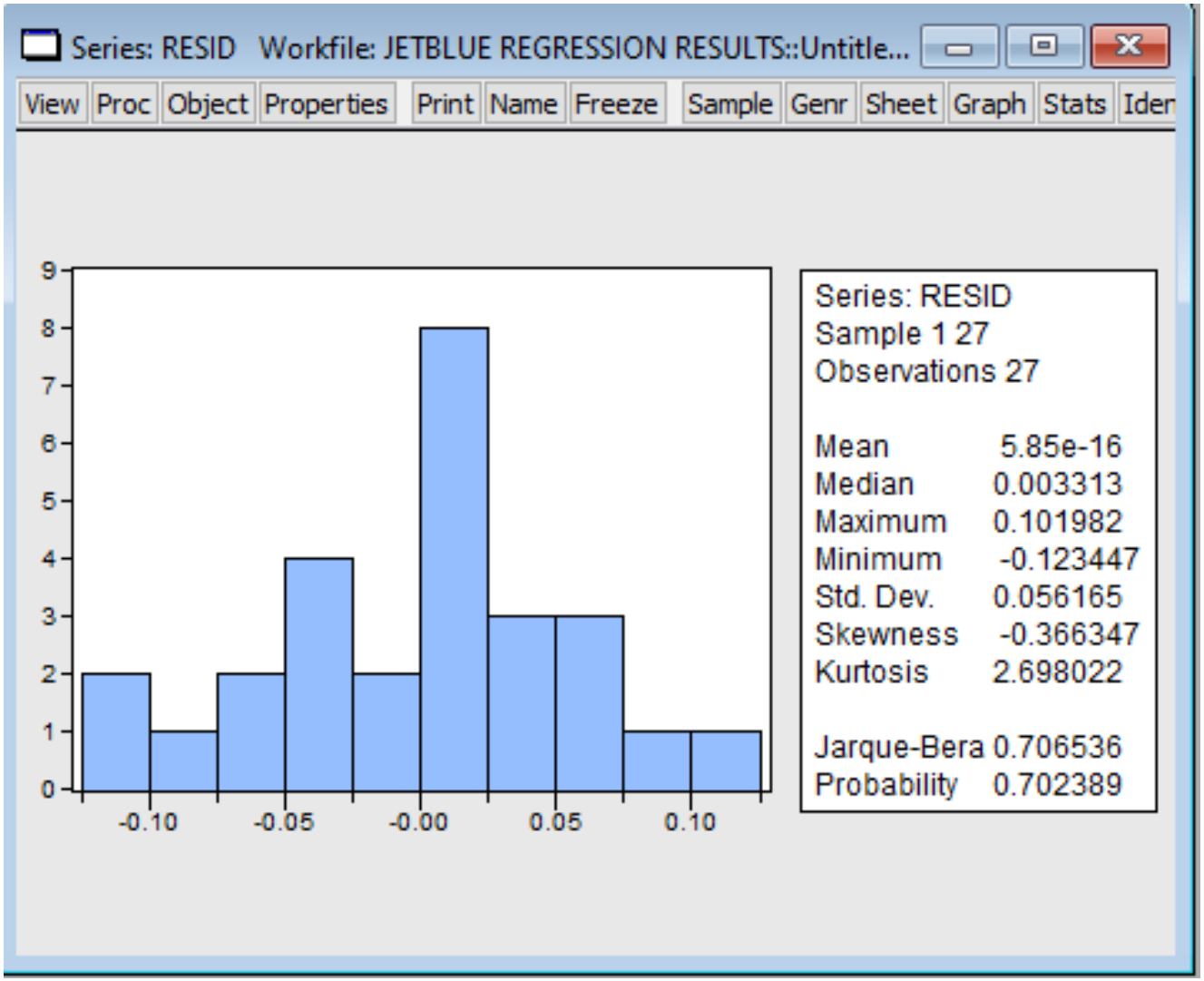
	Coefficient	Std. Error	t-Statistic	Prob.
C	17.95492	5.980394	3.002298	0.0095
LNF	-3.883720	1.203888	-3.225982	0.0061
LNF^2	0.214238	0.063727	3.361815	0.0047
LNF*N	-1.103836	0.357922	-3.084015	0.0081
LNF*BEFCOV	-0.004562	0.001524	-2.993536	0.0097
LNF*COV	0.141847	0.143736	0.986861	0.3405
LNF*AFCOV	0.023594	0.036268	0.650534	0.5259
N	9.240103	3.687764	2.505612	0.0252
N^2	1.834331	0.472330	3.883578	0.0017
N*COV	-0.019028	0.270657	-0.070301	0.9449
N*AFCOV	0.123448	0.089097	1.385542	0.1876
COV	-1.523586	1.649863	-0.923462	0.3714
AFCOV	-0.368925	0.390510	-0.944726	0.3608

R-squared	0.768241	Mean dependent var	0.003038
Adjusted R-squared	0.569591	S.D. dependent var	0.004034
S.E. of regression	0.002646	Akaike info criterion	-8.725095
Sum squared resid	9.80E-05	Schwarz criterion	-8.101174
Log likelihood	130.7888	Hannan-Quinn criter.	-8.539571
F-statistic	3.867309	Durbin-Watson stat	2.383346
Prob(F-statistic)	0.009257		

TEST ON THE RESIDUALS (CHECK FOR HETEROSCEDASTICITY):

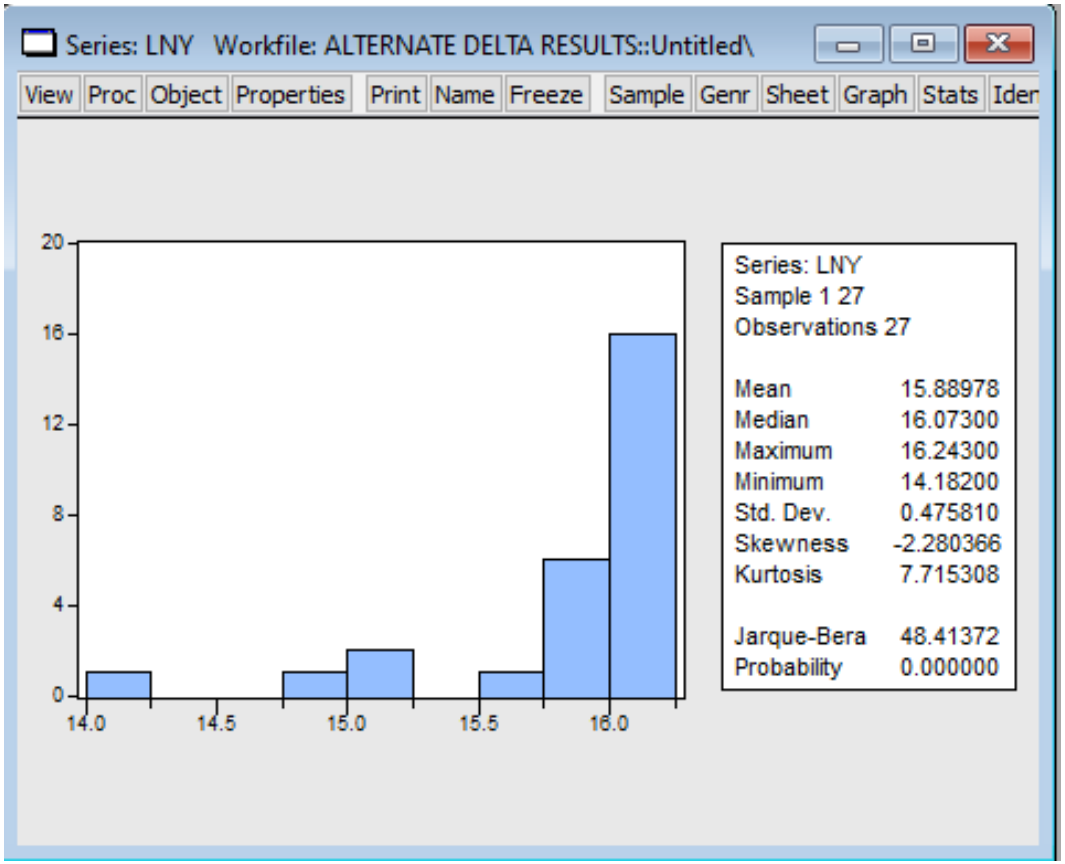
- Null Hypothesis of Homoscedasticity is rejected.
- All variables are dispersed at different levels.
- Reduces the validity of our estimated parameters.
- Model is not precise enough.

Test for Normality of the Residuals (Jet Blue)



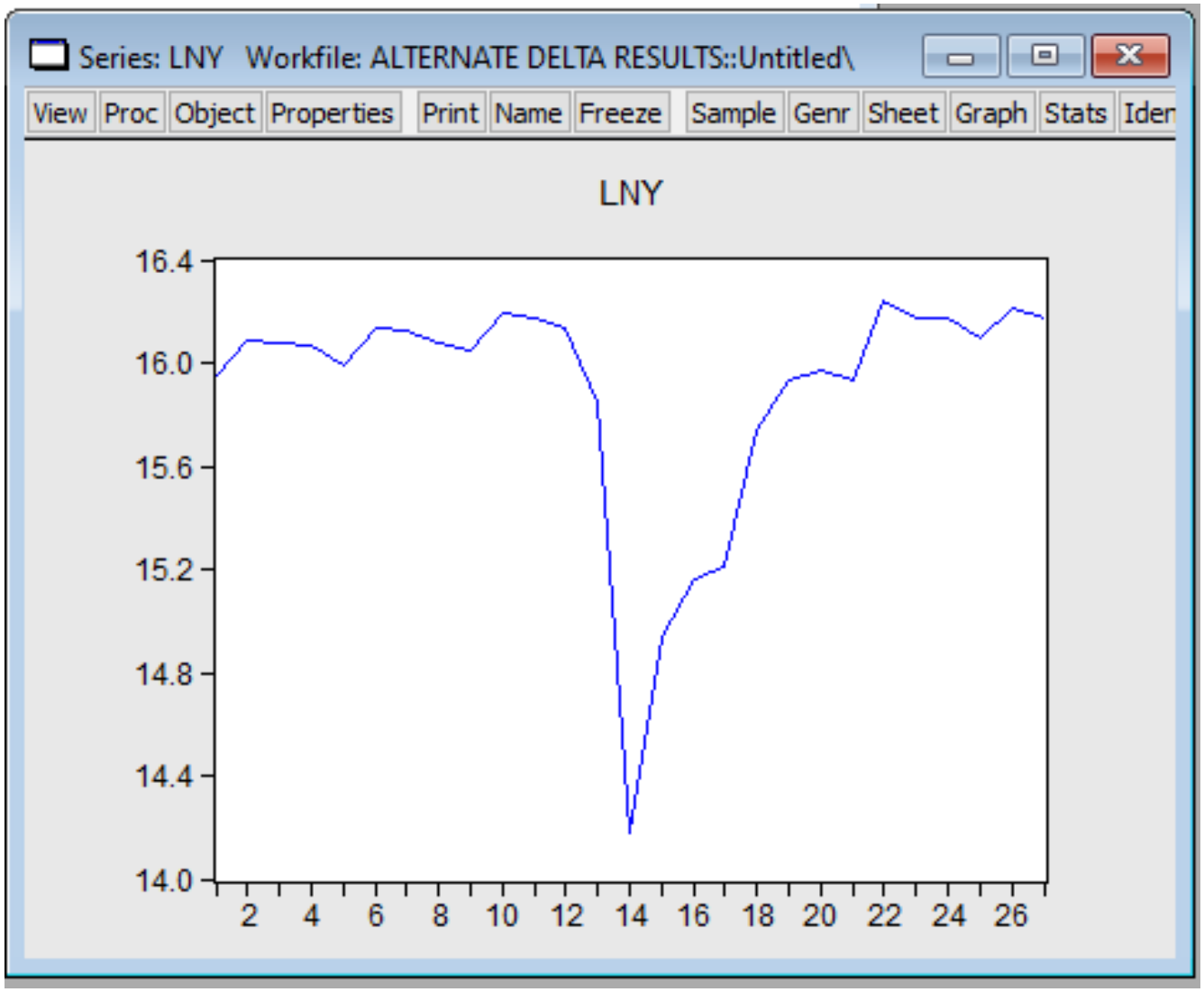
Normality of errors is accepted

Dependent Variable Distribution (Delta)



- Normal Distribution is rejected
- **Data not Normally Distributed: Left Skew**
- Lot of Outliers

Dependent Variable Distribution (Delta)



Regression Outcomes (Delta)

lny = 4.511 + 0.812*lnf + 1.743*n + 0.053*befcov + 0.170*cov + 0.079*afcov

EViews - [Equation: EQ01 Workfile: ALTERNATE DELTA RESULTS::Untitled\]

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View Proc Object Print Name Freeze Estimate Forecast Stats Resids

Dependent Variable: LNY
Method: Least Squares
Date: 01/16/24 Time: 16:36
Sample: 1 27
Included observations: 27

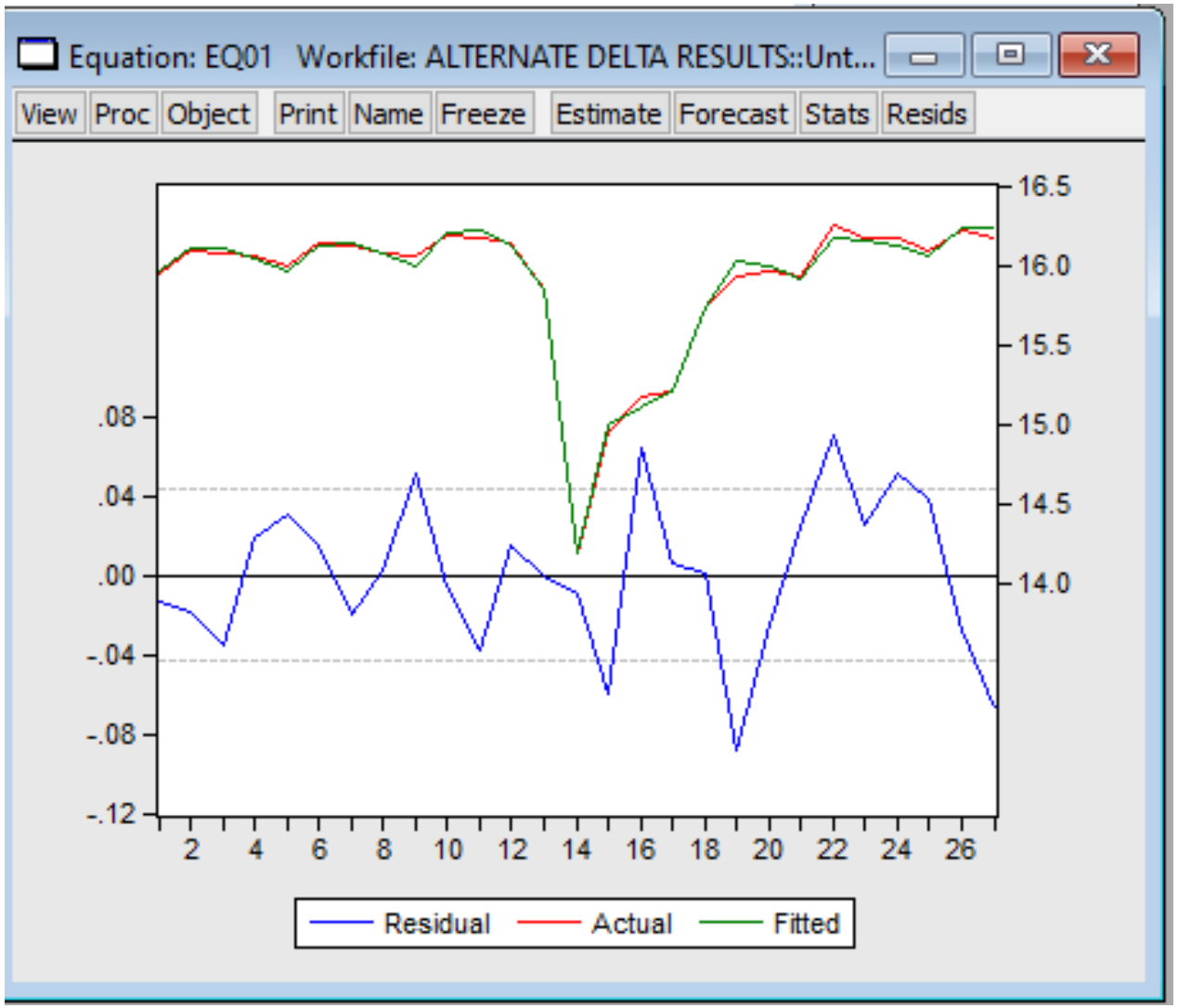
	Coefficient	Std. Error	t-Statistic	Prob.
C	4.510982	0.760753	5.929625	0.0000
LNF	0.812785	0.077887	10.43538	0.0000
N	1.743489	0.351336	4.962455	0.0001
BEFCOV	0.053474	0.064545	0.828474	0.4167
COV	0.170248	0.120825	1.409054	0.1735
AFCOV	0.079892	0.019428	4.112242	0.0005

R-squared	0.993208	Mean dependent var	15.88978
Adjusted R-squared	0.991591	S.D. dependent var	0.475810
S.E. of regression	0.043632	Akaike info criterion	-3.232932
Sum squared resid	0.039978	Schwarz criterion	-2.944968
Log likelihood	49.64458	Hannan-Quinn criter.	-3.147305
F-statistic	614.1933	Durbin-Watson stat	1.545923
Prob(F-statistic)	0.000000		

- Validity of individual explanatory variables: T- Statistic
- Validity of all explanatory variables: F- Statistic
- R^2 : 0.99
- Adj R^2: 0.99

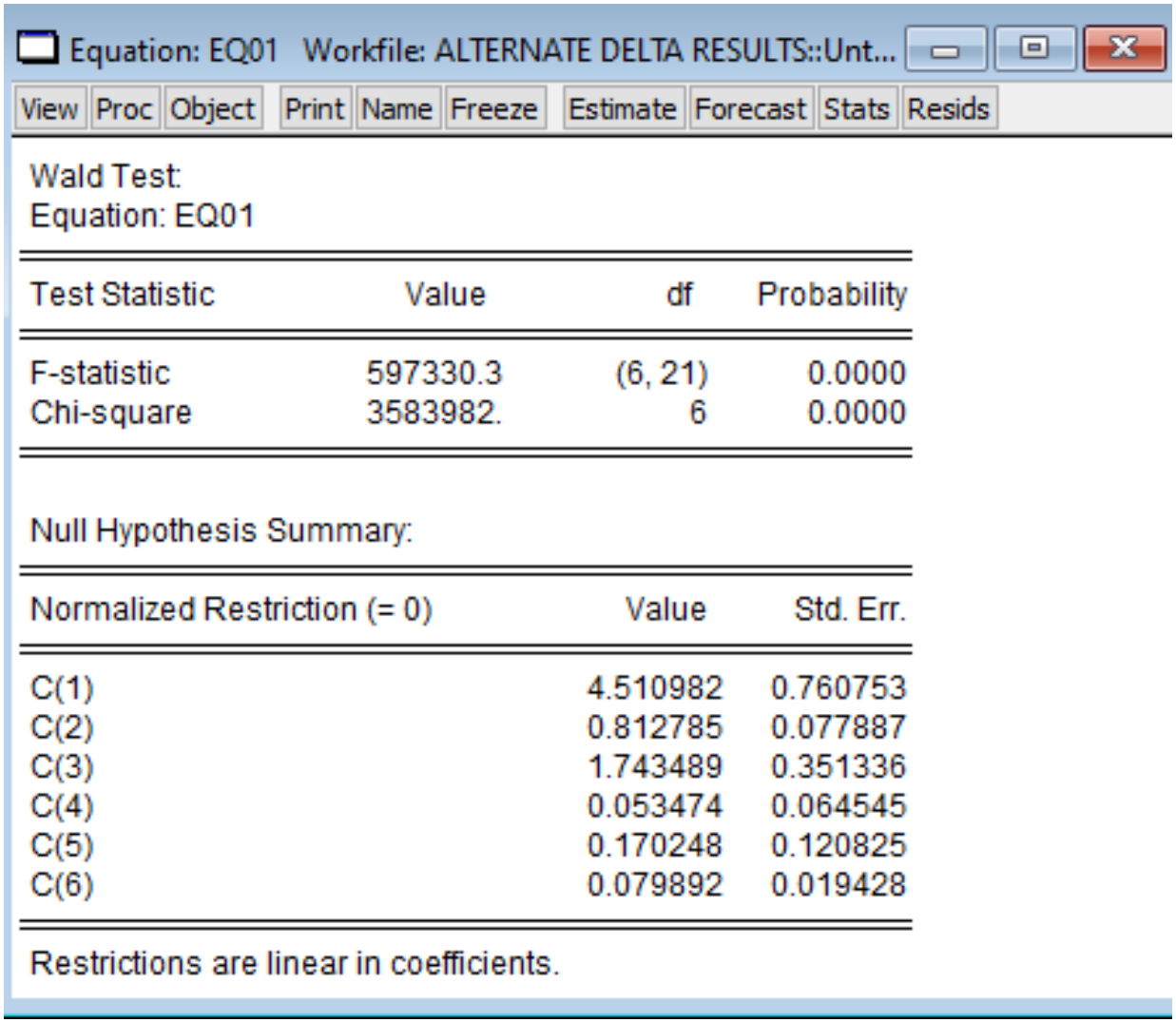
Note: Reject the validity of the "befcov" variable.

Regression Outcomes (Delta)



Wald Coefficient Restriction Test (Delta)

The values of the probability are 0 = All variables matter



Equation: EQ01 Workfile: ALTERNATE DELTA RESULTS::Unt...

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Wald Test:
Equation: EQ01

Test Statistic	Value	df	Probability
F-statistic	597330.3	(6, 21)	0.0000
Chi-square	3583982.	6	0.0000

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	4.510982	0.760753
C(2)	0.812785	0.077887
C(3)	1.743489	0.351336
C(4)	0.053474	0.064545
C(5)	0.170248	0.120825
C(6)	0.079892	0.019428

Restrictions are linear in coefficients.

Ramsay Reset Test (Delta)

EViews - [Equation: EQ01 Workfile: ALTERNATE DELTA RESULTS::Untitled\]

File Edit Object View Proc Quick Options Window Help

View Proc Object Print Name Freeze Estimate Forecast Stats Resids

Ramsey RESET Test:

F-statistic	1.375516	Prob. F(1,20)	0.2546
Log likelihood ratio	1.795875	Prob. Chi-Square(1)	0.1802

Test Equation:
Dependent Variable: LNY
Method: Least Squares
Date: 01/16/24 Time: 20:04
Sample: 1 27
Included observations: 27

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.276415	4.151000	-0.066590	0.9476
LNF	2.209305	1.193233	1.851529	0.0789
N	5.353463	3.097655	1.728231	0.0994
BEFCOV	0.179889	0.125343	1.435172	0.1667
COV	0.559629	0.352941	1.585614	0.1285
AFCOV	0.227110	0.126993	1.788365	0.0889
FITTED^2	-0.060418	0.051515	-1.172824	0.2546

R-squared	0.993645	Mean dependent var	15.88978
Adjusted R-squared	0.991739	S.D. dependent var	0.475810
S.E. of regression	0.043247	Akaike info criterion	-3.225372
Sum squared resid	0.037406	Schwarz criterion	-2.889414
Log likelihood	50.54252	Hannan-Quinn criter.	-3.125474
F-statistic	521.2094	Durbin-Watson stat	1.647906
Prob(F-statistic)	0.000000		

CHECKING THE LINEARITY OF THE MODEL (CA1):

Non-linearity is rejected at 82% level

White Test (Delta)

EViews - [Equation: EQ01 Workfile: ALTERNATE DELTA RESULTS::Untitled\]

File Edit Object View Proc Quick Options Window Help

View Proc Object Print Name Freeze Estimate Forecast Stats Resids

Heteroskedasticity Test: White

F-statistic	1.313085	Prob. F(12,14)	0.3101
Obs*R-squared	14.29712	Prob. Chi-Square(12)	0.2821
Scaled explained SS	7.370769	Prob. Chi-Square(12)	0.8322

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/16/24 Time: 20:05
Sample: 1 27
Included observations: 27
Collinear test regressors dropped from specification

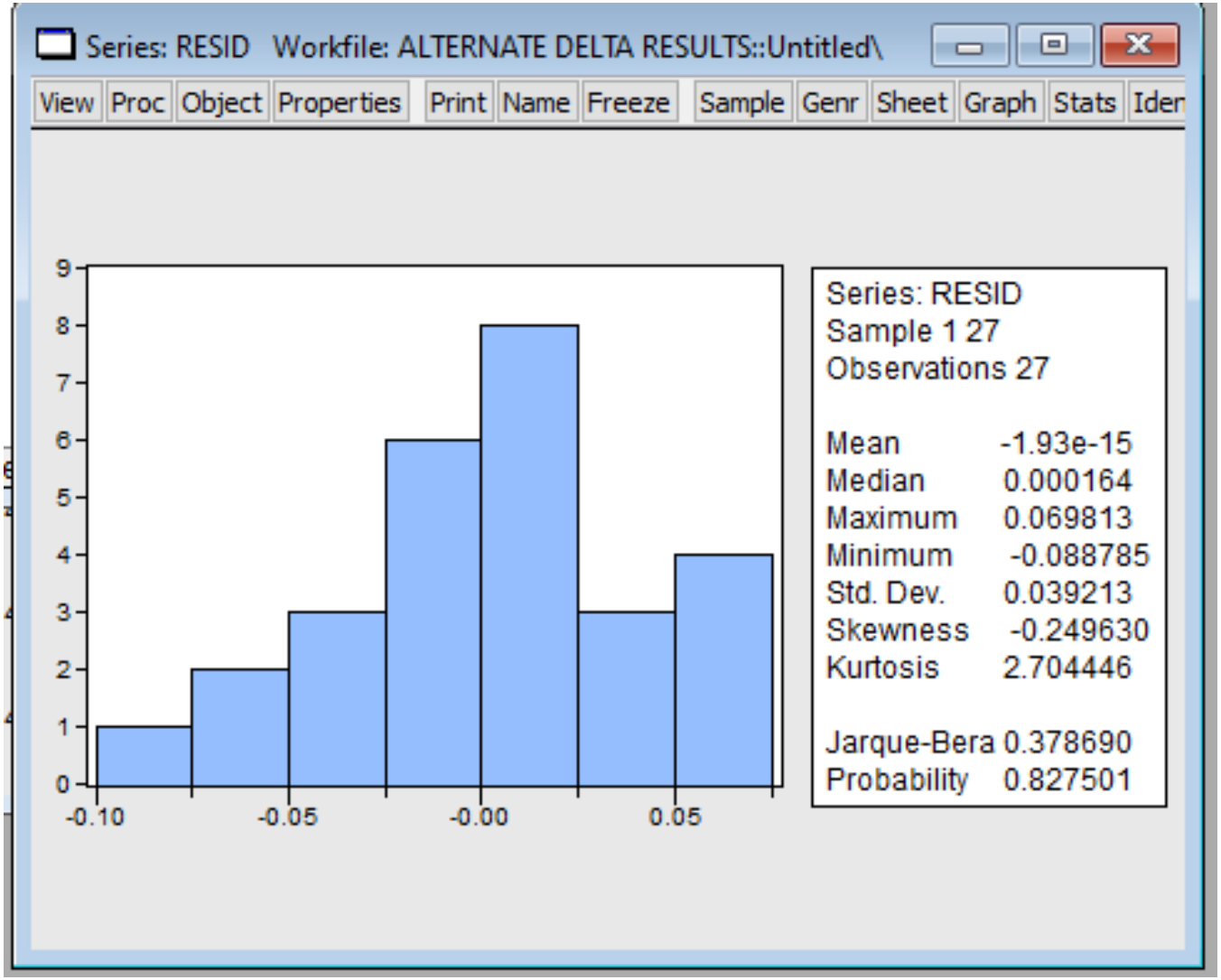
	Coefficient	Std. Error	t-Statistic	Prob.
C	2.187533	4.789432	0.456742	0.6549
LNF	-0.509321	1.031573	-0.493732	0.6292
LNF^2	0.027240	0.056428	0.482734	0.6367
LNF*N	-0.180917	0.496550	-0.364348	0.7210
LNF*BEFCOV	-0.000402	0.001044	-0.384889	0.7061
LNF*COV	-0.034972	0.164795	-0.212214	0.8350
LNF*AFCOV	-0.018795	0.018757	-1.002061	0.3333
N	2.151130	5.025362	0.428055	0.6751
N^2	0.027455	0.716012	0.038344	0.9700
N*COV	-0.128922	0.384889	-0.334958	0.7426
N*AFCOV	0.058571	0.066941	0.874974	0.3964
COV	0.489450	1.792095	0.273116	0.7888
AFCOV	0.183512	0.193283	0.949449	0.3585

R-squared	0.529523	Mean dependent var	0.001481
Adjusted R-squared	0.126257	S.D. dependent var	0.001970
S.E. of regression	0.001841	Akaike info criterion	-9.450434
Sum squared resid	4.75E-05	Schwarz criterion	-8.826513
Log likelihood	140.5809	Hannan-Quinn criter.	-9.264910
F-statistic	1.313085	Durbin-Watson stat	2.211815
Prob(F-statistic)	0.310089		

TEST ON THE RESIDUALS (CHECK FOR HETEROSCEDASTICITY):

Null Hypothesis of Homoscedasticity is accepted at 83% level

Test for Normality of the Residuals (Delta)



Normality of errors is accepted

Inferences for Jet Blue

- lny = 6.407 + 0.629*lnf + 1.118*n + 0.019*befcov - 0.376*cov + 0.033*afcov

Variables	Expected Sign	Actual Sign
lnf	+	+
n	+	+
befcov	-	+
cov	-	-
afcov	+	+

Table: Explanatory variables with signs for Jet Blue

- COVID-19 has a negative impact on Jet Blue Airlines

Inferences for Delta

- lny = 4.511 + 0.812*lnf + 1.743*n + 0.053*befcov + 0.170*cov + 0.079*afcov

Variables	**Expected Sign**	**Actual Sign**
lnf	+	+
n	+	+
befcov	-	+
cov	-	+
afcov	+	+

Table: Explanatory variables with signs for Delta

- COVID-19 has a positive impact on Delta Airlines

Success of the Model

All variables are valid except befcov

Model captured all the variability occurring in the dependent variable (adjusted $R^2 = 99\%$ for both Delta and Jet Blue)

Model observes the impact of COVID-19 on Jetblue to be consistent with real life observations.

Limitations of the Model

Model fails to observe the impact of COVID-19 on Delta that is consistent with real-life observations

Heteroscedasticity is observed on data with Jet Blue but not with Delta

Model does not account for the impact of volatile ticket fares and jet fuel prices

Conclusion

Rebuttable hypothesis has been falsified by our model.

Suspected unidentified impact on Delta and Jet Blue due to increased cargo transportation during COVID-19

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The End

Questions? Comments?