International Journal of Humanities and Social Sciences.
ISSN 2250-3226 Volume 3, Number 5 (2013), pp. 341-346

http://www.ripublication.com

Fiscal Deficit and Lending Rates

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The method of ORDINARY LEAST SQUARES (OLS):

The most frequently used method of obtaining the SRF (Sample Regression Function) as an estimator of PRF (Population Regression Function) in regression analysis is the method of ordinary least squares. It can best be explained in the following way:

Consider the two variable population regression function:-

$Y_i = B_1 + B_2X_i + u_i$..... (PRF).

where,

Y_i is the dependent variable corresponding to each independent variable X_i,

B_1 is the constant term.

B_2 is the slope coefficient.

u_i is the error or disturbance term in each observation.

Since the PRF is not directly observable, we estimate it from the sample regression function (SRF),

$Y_i = b_1 + b_2 X_i + e_i$..... (SRF).

where

b_1 is the estimator of B_1.

b_2 is the estimator of B_2.

e_i is the estimator of u_i.

Solving the two, we get

$b_1 = \bar{Y} - b_2 \bar{X}$

and,

$b_2 = \sum(x_i - \bar{x})\,(y_i - \bar{y}) / \sum(x_i - \bar{x})^2$

Features of the OLS estimators:

1. The SRF obtained by the method of OLS passes through the sample mean values of X and Y. $\bar{Y} = b_1 + b_2 \bar{X}$

2. The mean value of the residuals, $\bar{e}$ ($= \sum e_i / n$) is always zero.
3. The sum of the product of the residual 'e' and the values of the explanatory variable X is zero; these two variables are not correlated. $\sum e_i . X_i = 0$.
4. The sum of the product of the residuals 'e_i' and the estimated Y_i ($= \hat{Y}_i$) is zero. $\sum e_i . \hat{Y}_i = 0$.

We have,
e_i = Actual Y_i – Predicted Y_i
$= Y_i - \hat{Y}_i$
$= Y_i - b_1 - b_2 X_i$

The residuals are simply the differences between the actual and estimated Y values, the latter obtained from the SRF.

The method of OLS states that the b_1 and b_2 should be chosen in such a way that the residual sum of squares (RSS), $\sum e_i^2$ is as small as possible.

Minimize $\sum e_i^2 = \sum (Y_i - \hat{Y}_i)^2$
$= \sum (Y_i - b_1 - b_2 X_i)^2$

RSS is the function of the estimators b_1 and b_2 (once the sample values of y and x are given).

The values of b_1 and b_2 that actually minimize the RSS are obtained by solving the following two simultaneous equations:-

$\sum Y_i = nb_1 + b_2 \sum X_i$
$\sum Y_i X_i = b_1 \sum X_i + b_2 \sum X_i^2$

where n is the sample size.

These simultaneous equations are known as the Normal Equations.

Now presenting the data of Fiscal deficit and lending rates in Indian economy of last 30 years along with the values of the variables. (at the back).

OLS ESTIMATORSs

$b_2 = \sum (x_i - \bar{x})(y_i - \bar{y}) / \sum (x_i - \bar{x})^2$
$= -77247 / 226.575$
$= -340.933$
$b_2 \approx -340.9$
$b_1 = \bar{Y} - b_2 \bar{X}$
$= 1245.557 + 4793.054$
$b_1 = 6038.614$

t-TEST

We have,
$\sum e_i^2 = 7147996$
$n = 20$

n – 2 = 18

$\sum e_i^2$ / n-2 = 3971109.22

V (b_2) = $\frac{\sigma^2}{\sum X_i^2} = \frac{3971109.22}{6157.94}$

= 644.87

se = $\sqrt{V\ (b2)}$

= 25.394

HYPOTHESIS

$H_0 : B_2 = 0$

$H_A : B_2 \neq 0$

$t = \frac{b_2 - B_2}{se\ (b_2)}$

$= \frac{-340.9}{25.394}$ = - 13.4244 for n = 30 and n-2 = 28

t_{28} at any level of significance is less than 13.424. Hence, b_2 is significant and there is a negative relation between fiscal deficits and lending rates.

THE COEFFICIENT OF CORRELATION r AND COEFFICIENT OF DETERMINATION r^2.

The coefficient of determination measures the overall goodness of fit that will tell us how well the estimated regression line fits the actual Y values.

$r^2 = 1 - \frac{\sum e_i^2}{\sum y_i^2}$

where $\sum y_i^2$ is calculated for 8 values

$= 1 - \frac{476783}{9155034} = 0.947$

Therefore, r^2 is significant.

$r = \sqrt{r^2}$ = -0.973 (approximately)

The coefficient of correlation r is the measure of the strength of linear relationship between two variables x and y.

Hence, fiscal deficit and lending rates are strongly negatively related.

HETEROSCEDASTICITY

The examination of the data of residuals shows no discernible systematic pattern between e_i^2 and X suggesting that perhaps there is no heteroscedasticity in the data.

DURBIN WATSON d TEST FOR AUTOCORRELATION

The hypothesis to be set up here is

H_0 : no correlation between error terms or no autocorrelation
H_A : presence of autocorrelation.

And, d is calculated as
$d = \frac{\sum_{t=2}^{n}(e_t - e_{t-2})^2}{\sum_{t=1}^{n} e_i^2}$

We have calculated 'd' for the first 20 values.
So, $d = \frac{3179270}{7147796} = 0.444777$ (n = 20, n-2 = 18)

At
n = 20, $d_L = 1.201$
$d_U = 1.41$
and $d = 0.444777 < d_L$, hence we have the presence of autocorrelation.

And also, $d \approx 0$, hence error terms are positively correlated.

Hence,The final conclusion is that fiscal deficit in India and its lending rates are highly negatively correlated and thus the monetary policy makers have to be cautious enough when making monetary plans and its consequent decisions.

Lending Rates (in %) X_i	X_iY_i	X_i^2	$\hat{Y}i$	$ei = Yi - \hat{Y}_i$
18	1398.6	324	1532.27	-1454.57
18	1884.96	324	1532.27	-1427.55
17.5	2370.2	306.25	1495.885	-1360.445
17.5	2981.3	306.25	1495.885	-1325.525
16.5	3041.115	272.25	1423.115	-1238.805
16	3323.2	256	1386.73	-1179.03
16	3795.52	256	1386.73	-1149.51
16	4910.72	256	1386.73	-1079.81
19	4678.18	361	1605.04	-1358.82
17	5139.44	289	1459.5	-1157.18
14	6439.16	196	1241.19	-781.25
15	6076.95	225	1313.96	-908.83
16.5	7001.28	272.25	1423.115	-998.795
14.75	6857.865	217.563	1295.768	-830.8275
14	8828.68	196	1241.19	-610.57
12.5	9993.125	156.25	1132.035	-332.585
12.25	11013.98	150.063	1113.843	-214.7425
11.5	12403.21	132.25	1059.265	19.275
11.5	14153.51	132.25	1059.265	171.475
11.125	14888.48	123.766	1031.976	306.31375
10.6	12249.15	112.36	993.772	161.808
10.6	13382.71	112.36	993.772	268.748
11.5	16760.45	132.25	1059.265	398.165
13.5	20418.08	182.25	1204.805	307.645
14	16899.96	196	1241.19	-34.05
14.2	46721.41	201.64	1255.744	2034.496
13.4	55134.03	179.56	1197.528	2916.952
8.9	30776.47	79.21	870.063	2587.967
10.4	53593.8	108.16	979.218	4174.032
10.1	51021.26	102.01	957.387	4094.223
421.825	448136.8	6157.94		-1.79525
14.06	14937.89	205.265		**-0.059841667** (approx. 0)

X-E(X)	[X-E(X)]2	Yi-E(Y)	xiyi	ei2	[Yi-E(Y)]2	E_t-e_{t-1}	$(E_t-e_{t-1})^2$
3.94	15.5236	-1167.86	-4601.368	30725.18	1363897	27.02	730.0804
3.94	15.5236	-1140.84	-4494.91	40927.72	1301516	-139.73	19524.47
3.45	11.9025	-1110.12	-3829.914	3915.756	1232366	34.92	1219.406
3.45	11.9025	-1075.2	-3709.44	9505.47	1156055	-326.95	106896.3
2.45	6.0025	-1061.25	-2600.063	52649.14	1126252	-147.06	21626.64
1.95	3.8025	-1037.86	-2023.827	141762.8	1077153	29.52	871.4304
1.95	3.8025	-1008.34	-1966.263	120404.8	1016750	69.7	4858.09
1.95	3.8025	-938.64	-1830.348	76891.96	881045	962	925444
4.95	24.5025	-999.34	-4946.733	468822.3	998680.4	-625.7	391500.5
2.95	8.7025	-943.24	-2782.558	3481.708	889701.7	-865.08	748363.4
-0.05	0.0025	-785.62	39.281	649755.3	617198.8	286.09	81847.49
0.95	0.9025	-840.43	-798.4085	270383.4	706322.6	530.54	281472.7
2.45	6.0025	-821.24	-2012.038	111.4291	674435.1	-555.955	309086
0.7	0.49	-780.62	-546.434	297460.1	609367.6	-89.995	8099.1
-0.05	0.0025	-614.94	30.747	403725.5	378151.2	-342.52	117320
-1.55	2.4025	-446.11	691.4705	956315.8	199014.1	14.425	208.0806
-1.8	3.24	-346.46	623.628	928311.1	120034.5	-76.235	5811.775
-2.55	6.5025	-167.02	425.901	1081026	27895.68	152.2	23164.84
-2.55	6.5025	-14.82	37.791	787698.9	219.6324	-20.2875	411.5827
-2.925	8.555625	92.73	-271.2353	824121.7	8598.853	-361.6825	130814.2
-3.45	11.9025	-89.98	310.431	1611615	8096.4	106.94	11436.16
-3.45	11.9025	16.96	-58.512	1351532	287.6416	501.72	251723
-2.55	6.5025	211.87	-540.2685	436701.6	44888.9	736.82	542903.7
-0.55	0.3025	266.89	-146.7895	5773.872	71230.27	-134.86	18187.22
-0.05	0.0025	-38.42	1.921	3466.148	1476.096	2151.28	4628006
0.15	0.0225	2044.68	306.702	4378163	4180716	551.52	304174.3
-0.65	0.4225	2868.92	-1864.798	6990345	8230702	-2190.5	4798290
-5.15	26.5225	2212.47	-11394.22	205595.1	4895024	2206.57	4868951
-3.65	13.3225	3907.69	-14263.07	7075579	15270041	-203.91	41579.29
-3.95	15.6025	3806.05	-15033.9	6032358	14486017	-2456.086	6032358
	226.5753		-77247.22	7147996	9155034		3179270

THE END